Can current design and development management pedagogy respond better in reflecting industry needs?

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By
Walter Brown Herbst

A thesis submitted in partial fulfilment of the University's requirements for the Degree of Doctor of Philosophy

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Abstract

The purpose of this study is to bring clarity and consistency to the academic field that concentrates on management of product design and development.
The research explores the assumption that no common standards exist for the education of those wishing to assume a managerial position in that field.

The findings have shown a significant lack of consistency in both the subjects offered as well as the naming of the subject in terms of the public presentation. As such, those who wish to enter the field, as well as those wishing to hire leadership, are met with dramatically varied educational background and degree titles.

This study presents a review of all identified existing graduate programmes —of which there are 35 institutions worldwide, teaching 60 different courses, with 24 separate degree names.

This research explores and identifies the most relevant courses in response to leaders in industry. In his work, Schön (1983) references relevancy in terms of competence that is valued in professional practise as opposed to knowledge taught in academia, and this thesis explores what is practiced and what should be taught.

Three distinct groups within the USA were interviewed, including the following: 1) eleven educators responsible for these programme , 2) twenty design-centric industry leaders who hire managers for professional practice, and 3) ninety alumni who have graduated from one particular programme. The tacit knowledge of key leaders needs

and the general references made to relevance over rigour are the impetus for the study. Valuing and addressing industry needs and ultimately recommending a course of action that aligns academic training with a more industry relevant content has been the overriding direction for this work. It is that debate that this research, for the first time, addresses the wants of industry, through clarifying eight specific courses to satisfy the need for trained graduate students in the role of management of product design and development within the context of the USA.

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Chapter 1: Introduction

1.1 Introduction and Genesis of the Study

In 2001, the author established, the first programme in the USA dedicated to product design and development management at Northwestern University in Evanston, Illinois, USA. Having started the programme 16 years ago, in 2001, this study has identified an additional 16 schools in the USA that have similar programmes along with a total of 38 internationally. Upon additional exploration, 60 course offerings have been identified (refer to Appendix A).

My interest is in understanding the disparity of courses and establishing if there should be an underlying thematic that would offer consistency of content. The objectives include exploration as to how core coursework should be identified and who should be the determining party for a recommended field of study.

It is intended this study presents the identification of a core curriculum appropriate for those in industry that will be employing these graduates.

1.1.1 Personal Journey

In 1961, I entered the professional field of industrial design and chose the route of consultant design practice. After a few years of working in the field, I became a partner in a small consultancy, Sherman Design, which became Sherman Herbst Design. I ultimately took ownership of the firm and developed it into the largest independently owned consultancy in the USA in 1996. The company was Herbst LaZar Bell (HLB),

and the practice grew to over 100 professionals in three USA cities: Chicago, Boston, and Los Angeles (see Appendix B; Definitions). The firm included industrial designers; mechanical, electrical, and software engineers; research professionals; and a prototype facility.

Approximately 40 years after founding the firm, the ownership was transferred to the employees under employee stock ownership plan (ESOP) rules. The move was concurrent with my new Northwestern University role of transferring from a part-time adjunct faculty member to a full-time clinical professor. The move was required in order to plan and organise a new masters degree programme at Northwestern University. The programme was dedicated to training professionals in the field, on a part-time basis, for advanced work in product design and development management. That transition took place in the year 2000, and the programme of study was the first in the USA dedicated to the subject matter. In order to assure a successful programme, I developed a professional advisory board of senior management in the field of product design and development. The advisory board was initiated to ensure relevance to the subjects being taught.

Sixteen years after starting the first programme in the USA, there are now a total of 38 programmes worldwide, which include 16 additional new programmes in the USA. As such, I took a deeper look at reviewing coursework, hoping to find consistency amongst the institutions in this field. The question of consistency appeared relevant, as my board of advisors and I were concerned regarding potential employers' unfamiliarity with this new management degree, amongst a crowded field of MBAs (those with master's of business administration degrees). If little to no consistency of course work was found

amongst those programmes, confusion regarding understanding of a common subject matter could denigrate the degree, versus the standard course work expected of those earning an MBA.

As an academic, living in the world of professional design, I recognised that a formal review was necessary. My ultimate goal is to define the category with a structured curriculum to assure employers consistency in understanding skill levels of any graduate with this type of degree.

1.1.2 Aims, and objectives overview

According to 'Solent Online Learning' (Solent Learning and Teaching Institute, n.d.), Aims are what one wants and hopes to achieve, whilst objectives describe how one will achieve it using specific defined measurable outcomes..

The basic aim of this research study is to understand the general state of masters' programmes in the field of product design and development or innovation management. and to understand who is teaching what coursework, with an objective based on industries perceived needs. The final objective is to have a basic set of core classes taught worldwide to assure industry leadership that when hiring one with a degree in product design and development management, he or she will have a common and needed set of skills based on what industry leadership 'wants'. To achieve that objective a defined a structured curriculum will be based on industry leadership needs.
The work will review the offering worldwide in master's-level programmes specialising in product design and development.

The outline of aims, and objectives is as follows:

Aims:

1. Identify those institutions worldwide that offer degrees in the general subject of product design and development management.
2. Identify all coursework taught in the above programmes.
3. Identify the names of the degrees award from the above programmes.:
4. Identify from alumni of one programme that offers the above degree, those courses available from all schools that those alumni believe to be most important.

Objectives:

5. Identify the core programmes that those in academia and industry leadership believe to be most important.

1.2 Introduction to the Research

This study involves the search for an understanding of professional needs, concurrent with understanding the subject matter currently being taught for graduate programmes dealing with product design and development management. The purpose of the study is to develop a recommendation for a standardised course baseline for those professional master's-level programmes. The research and the quest in general are directed solely to those institutions offering degrees in product design and development. The purpose of the study is to find a standard for the teaching of the subject matter, based on professional practice and the opinions of industry leadership, that will be able to stand up to peer review. The reason for the standard is to assure those hiring that they will be receiving graduates with common coursework, based on leadership needs. Leadership,

based on research, has an expectation of core competency of specific subject matter. The reality, revealed by the research already undertaken, is that no common standards exist for managerial training for those involved with product design and development management. That comment is based on a review of 35 international intuitions teaching the basic subject matter, of which 17 are in the USA, including the author's own programme.

1.3 Statement of the Problem

The problem is rooted in the fact that unlike graduate master's degrees in business administration, commonly known as MBAs, one has little to no idea what coursework might be included in a design / development / innovation management type of degree.

In addition to the consistent lack of skill sets taught, the various programmes have titled themselves with little consistency. This lack of common title, could allow for the end user responsible for the hiring of leadership in this field, the conclusion that hiring from the schools that offer degrees in this field will only lead to a 'best guess' as to the knowledge that a graduate will bring forth.

1.4 Background of the Landscape

Once one answers the question, 'what is it that those in leadership desire when hiring their next managing director of design and development', the next issue to be reviewed is the lack of commonality of coursework and resulting skill set amongst institutions. As a basis, all educational programmes in this field, recognise there is some business/managerial component to the teaching of the subject. Thus, it is appropriate to

review one of Schön's writings relative to business practice teachings. He references different writers on the subject of real business knowledge in the world versus academia's interpretation of those needs. His references include Edgar Schein, Nathan Glazer, and Herbert Simon: 'Each of these writers has identified a gap between professional knowledge and the demands of real-world practice' (Schön 1983: 45). The gap noted by Schön in 1983, is still relevant today within the field of product design and development as noted by Ash (2014) referencing "an alarming and growing gap". Barley, *et al.* (1988: 24) review what they assess as two sub cultures, academics and practitioners, and their influence on each other viewed through 192 articles. They conclude; "academics appear to have moved toward the practitioners point of view, while the latter appear to have been little influenced by the former".

The questions that need to be addressed are, 'what is driving these variables in the teaching of the general subject' and 'why does one find a field of 60 different courses amongst 35 institutions'? Of concern is the overriding decision for the teaching of these various courses based on what is commonly known as rigour or relevance. Rigour is commonly thought of as learning and understanding tasks, while relevance is commonly thought of relative to real world problem solving (Daggett, 2009). The question is as follows: 'Are the academicians who create these programmes in tune with the leadership who will hire these graduates, or is there a greater allegiance to the world of academia where the 'publish or perish' attitude is critical for tenure, research funding, prestige, and thus advancement'? Inasmuch as my own research has identified a chasm between leadership needs and academic teaching, it is realistic to propose that academia is failing by not preparing career ready graduates. If academia is failing the students, it is failing the audience of those wishing to hire qualified managers in this field.

In his writings, Ash (2014) questions the same issues in a similar subject matter. He discusses the differences in education that are based on rigour or relevance from the academic perspective. This is a reference to research studies where he refers to Baron (2011), who argues that 'the rigour required for academic publishing makes practice relevance hard to include' (Ash 2014: 25). Ash continues, citing Bansal (2012), who asserts that 'academic research often completely fails to address practice interest … lacking relevance as it is little used by practitioners' (Ash 2014: 25).

Another supporting comment on the subject of rigour versus relevance is discussed at length by Bennis and O'Toole (2005) in which they put forth the argument that schools (in this case business schools) are on the wrong track in not paying enough attention to the reality of the workplace and by allowing faculty to be consumed by publishing based on research that may not be embedded in a practice-based reality. The authors, both senior professors at the University of Southern California and the Marshall School of Business in Los Angeles, profess that graduates fail to have useful skills, as not enough of them are being taught those skills. This latest written comment on the general subject is what drives this study The author as a director of one of the top schools in the world (*Business Week* September 2009), teaching the subject of management of product design and development, to attempt to bring greater clarity and direction for all those in the business community.

If in fact we are not bringing value to both the students and the business community that has needs for management in design and development, then we are doing little more

than warehousing students who ultimately will not contribute to professional practice in this area of study. It is this passion for contribution that is driving this research.

1.4.1 Starting point to identify boundaries

Grix notes, ontology is 'the basic image of social reality…upon which a theory is based' (2010: 170). Using that as a basic description, the ontological assumption is that no common standards exist for managerial education for those involved with product design and development management. This statement is made as a result of the reflective research where the starting point was the identification of institutions dealing with the teachings of the general subject of product design and development management. The naming of the subject matter, 'product design and development management', represents just one of the many-named descriptions of the programme offered by the 35 institutions. Similarly, there is a wide divergence in the naming of degrees awarded (see Appendix C) .

A web-based search was initiated using combinations of words dealing with the general subject. The search referenced volume 25, issue 1 of the *dmiReview* (the Design Management Institute's, or DMI's, publication). The issue, entitled *Designing Education*, included a report, 'Redesigning Graduate Education' (Hardin, *et al.,* 2014) that was a synopsis of the DMI's 'futurED' conference held in Chicago on 20 August 2013.

The subsequent search of programme in this field of interest led to the identification of 35 programmes internationally, offering a master's in this area of study. Of the 35 identified institutions, a review of the degrees awarded resulted in the finding of 24 separate degree names. All secondary degree descriptors of the institutions in this category appear to have a central theme of leadership and management competency as part of the advanced study of design and development. The degrees include some combination of the following descriptors: product, development, integrated, design, management, innovation, strategy, product, services, leadership, MBA, strategic, industrial, arts, and engineering.

1.4.2 Geography of the boundaries

At this point, it is important to state the boundaries of this research. The research began with an overall worldwide appreciation of those subjects deemed important to the 35 worldwide institutions, based on what is taught. In this case, the scope of the research is focused on the general subject of product design and development and/or innovation. A deeper understanding was to be sought based on subsequent interviews and comments that are USA-centric only. They include educators, senior level professionals from design-centric organisations, and alumni. The ultimate conclusions are based on this USA context exclusively.

The boundaries are in place to assure end user needs when ultimately recommending areas of study, based on the research conducted. As such, the views of others within the introduction are also based on USA institutions, albeit the areas are related but not absolutely similar.

1.4.3 Reality of the subject

The concern with the current system of various degree names and various major subjects of study is the problem of potential confusion in the marketplace. This level of confusion may impact the hiring of graduates, as the hiring audience will not have a standard, relative to expectation. Whatever the degree name, for one involved in the hiring, there is an expectancy of proficiency in the subject matter and relevant skill set. The expectancy of proficiency in the subject matter would then naturally raise the question: just what is the subject matter? Based on the 24 separate degree names, the audience of those interested in someone with such a degree might, at best, suggest confusion and at worse, be misled.

The confusion is based on evidence that there is no standard for those receiving this degree nor their skill set. The evidence is that there are 24 degree names amongst the 35 institutions. This lack of consistency is reflected in the variance of coursework. I have to agree with my former colleague at Northwestern University, Don Norman, who, according to Ash (2014: 1), wrote that the ‘gap between the two communities is real and frustrating’. Norman (2011) was referring to the business community and the academic community. The confusion is based on lack of consistency of coursework and adds to the question of what the specific skills are that one leaves these institutions with.

This gap continues, and whilst not specifically referencing the field of product design and development, McCole (2004) references the field of marketing, and recognises the gap between academia and the profession. The reference is made to McCole and his

marketing discussion, as the subject of marketing is taught in 17 of the 35 programme dealing with product design and development management.

The gap between researcher and practitioner is also referenced by Rynes, *et al.* (2001), and according to the authors, the gap is not only not a new issue but additionally not restricted to the business sciences as taught in business schools. They also discuss what they call a crisis in the field of organisational science. Whilst this paper is not a review of business school teachings, it nevertheless recognises that classic business-type subjects are an important component of all curricula in this field.

1.4.4 Boundary bias

Since the ultimate conclusions are based on senior-level design-centric leadership responses, the question might arise regarding bias amongst the representative group of leadership selected. Bias could arise from a number of places. One bias in particular, might arise as a result of this level of leadership involved in what Tovey (2015) refers to as 'communities of practice'.

I reference this work, to recognise that the phrase 'communities of practice' is more often related to those who *teach* this subject rather than those who *lead* design-centric organisations. For design professionals within the USA, the 'community of practice' would be limited to the only national forum, which is the Industrial Design Society of America (IDSA), who hold one annual meeting per year. The point is made, as bias might be a result of academic presenters 'talking to themselves' as a result of multiple conferences and paper presentations. This distinction, as prior research in allied fields

confirms, is that professionals are not looking toward academic research for the next level of breakthrough thinking in this area as noted earlier by Barley, (1988) *et al.*

The point is made of this difference, as Tovey (2015) references the work of Lave and Wenger (2000) in 'communities of practice'. This 'communities of practice' grouping includes those professionals in the same discipline who actively participate in discussions and discourse. The basis, according to Wenger (2000), is the 'lived experience of participation in the world'. From Wenger's point of view, as expressed by Tovey (2015: 38), this community should "interact regularly to learn how to do it better".

For this study with senior leadership, the evidence for non-biased individual response is based on disparate backgrounds as well as geography. The respondents came from the east and west coasts well as the central part of the USA. Due to the size of the USA, the six different regions are noted, as there are cultural differences in the regions. According to the USA Study Guide (n.d.), there are actually six major regions of the USA, with noticeable differences not only in climate and landscape but also in the people who live in those regions. The regions as cited by the US embassy (2008), include: New England in the north-eastern corner of the US; the Mid-Atlantic states on the east coast; the South which extends from the east cost to the southern tip of the US and continues to the southern Midwestern section of the country; the Midwest which would include the centre of the US extending north to the Canadian border; the Southwest, which extends from the central part of the US to the southern board and the West, which extends to the west coast.

Core interests of responders companies range from leadership in areas as diverse as pets to cars to defence (see Appendix D). Additionally, while the interviewees undergraduate studies include industrial design, civil engineering, electrical engineering, mechanical engineering, English literature, graphic design, and physics, to name just a few, most all have graduate degrees with many being MBAs. I note that as communities of practice do exist in some of the above undergraduate disciplines, however, they do not exist at the MBA level, other than on an individual institution basis. The above-noted communities of practice include Institute of Industrial Engineering, Society of Manufacturing Engineers, Society of Professional Engineers, Industrial Design Society of America (IDSA), Institute of Electrical and Electronics Engineers (IEEE), and American Institute of Graphic Arts (AIGA) to name just a few. Thus a degree of peer association is almost non-existent amongst the senior professionals who are referenced within this study. While information in the form of lectures is justification and rationalisation for these professional meetings, there appears to be an underlying reason for attending and/or presenting. One of those reasons, confirmed by the amount of conference support, is external professional support relative to products, services, trends, techniques, and materials available from suppliers wishing to extend their knowledge and potentially their customer base. Conference support refers to the individual sponsors who help defray costs of these industry events.

A secondary reason is the value of networking. An example of professional support would be recognition that the exhibitor prospectus for the 2015 American Institute of Architects (AIA) convention lists 747 exhibitors. The IDSA, in their 2015 advertising brochure, lists 88 exhibitors from the prior year. Of the 88 exhibitors, 40 are identified as exhibiting for the sole basis of hiring amongst those who were attending. The point of

these statistics is made because senior leadership with authority and/or influence in choosing directors of design and development would most likely not have interest in this type of professional venue addressing these specific industry areas of interest.

Senior leadership in the USA does have occasion to meet at venues that include the Aspen Institute as well as at TED (Technology Entertainment Design) conferences, which are organised as non-profit structures. The principal reason for these events is to listen to and learn from featured speakers. TED conferences are organised under the slogan ‘ideas worth spreading’, which is their by-line. Talks include scientific, cultural, and academic events. With roots in technology and design, the conferences began in the Silicon Valley region of the USA (Ted, n.d.). With a structure devoted to the above areas, those attending do so for the formal learning from experts, albeit some networking takes place.

The Aspen Institute (n.d.-a) has a self-described mission: ‘to foster leadership based on enduring values and provide a nonpartisan venue for dealing with critical issues’. Issues from this past year’s programme include seminars on what makes a good society, global issues dealing with urban challenges, and economic development (The Aspen Institute n.d.-b).

Whilst the leadership of design-centric organisations that are incorporated into this study may not, as a group, necessarily subscribe to the same publications as designers might, that may aid in ‘community’, those that are known to the researcher, in general, subscribe to a vast array of both conservative and progressive business-related

publications. Publications might include the *Wall Street Journal*, *Fast Company*, *Fortune*, *Bloomberg Business Week*, and *The Economist*.

1.5 Desired outcomes

The desired outcomes of the thesis sections are outlined as follows:

1. An understanding of the variances of institutional teachings in terms of coursework. The audience for this effort will be academics, design-centric industry professionals, and alumni from a programme in product design and development management. Particular attention will be paid to those in industry leadership with an interest in bringing consistency within this area of education. The recognition is that an organisation's desire is that new leadership will be purposefully trained in this area.
2. A literature review that reflects the general subject matter and includes pedagogical issues, PhD-related writings, and reviews as seen from the viewpoint of those in professional practice.
3. Findings from the methods chosen to review this subject matter, and the drivers behind the ontology and epistemology, will be designed to assure a qualified peer-reviewed work.

Findings, are presented as well as a summary, based on questionnaire. The specifics of the research questions are to understand the following:

1. What subjects do each of three basic groups (academics, professional leadership, and alumni) consider to be of importance for the future role of candidates who will manage product design and development departments?
2. A second objective is to establish a numeric values of all the subjects being reviewed. The aim is to be a purposive sampling of the three groups. The sampling

allows for an interpretivist understanding of what could otherwise be a subjective and biased experience. In this case, interpretivist is ‘an approach to qualitative research’ (Creswell 2009: 8), with the ultimate deliverable being a recommended course of study for the subject matter.

1.6 Significance of the Subject

Since the first master’s programme dedicated to product design and development management was introduced in 2000 in the USA at Northwestern University, an additional 37 programme have since joined the field. Each new entry has brought with it different coursework and 24 different names for the programme . Based on meetings with senior leadership in design-centric organisations, the various programme with various names have added confusion to the qualifications of the individuals and the actual skill set, of those graduating from these programme . This study will, for the first time, quantify what leadership is expecting from graduates of this discipline. Based on that expectation, it is intended that a new epistemology will be globally adopted and that expectations will be fulfilled.

1.7 Naming: Background and Justification

The Northwestern University programme entitled Master of Product Design and Development Management is entering its sixteenth year. It was the first programme of its kind in the USA. Whilst 34 additional programme are now taught worldwide, there is still a question of identity based on the numerous names given to these programmes . The researcher is the founder and director of the programme and ‘the face’ of the

programme, and notes being queried on context. Questions from prospective students to prospective employers range from ‘is this an MBA with a concentration in design and development?’ to ‘is this programme the same as an engineering management degree?’

In an attempt to alleviate the questioning as to what the programme was and/or is, the programme has undergone three major name changes in the last 15 years to better reflect the audience needs. Audience refers to both the students and the organizations supporting their education. The original name was Master of Product Development. The degree that was granted was also titled Master of Product Development. In its sixth year, the programme went through a name-change to better reflect the teaching that took place, and to address the cultural changes needed, albeit the actual basic coursework varied minimally. The programme name-change was coupled with a degree name-change. The programme name-change was Master of Product Design and Development, and the degree name-change was Master of Science in Product Design and Development. In its tenth year, another change took place to better represent to the professional community the reality of the place in the community that these graduates would take. As such, the third and current naming became Master of Product Design and Development Management. The ‘master of science’ preface remained.

One could argue that rather than the name ‘Master of Product Design and Development Management’, a better ‘read’ could be accomplished by moving the individual increments of the name to allow the name to be called ‘Master of Management in Product Design and Development’. Whilst this was preferred, the silo nature of the university allowed the business school to believe they ‘owned’ the name ‘management’.

Thus, the term ‘management’ for this programme had to take a ‘back seat’ and could not lead in the re-naming.

1.7.1 Naming extensions

Other institutions, starting with the Stanford “D” school, and noted in a conversation with one of the leadership of that program, followed Northwestern University’s Product Design and Development Management programme and developed their own programme, albeit the Stanford program did not lead to a specific degree. As could be expected, other institutions in developing their own programs also developed their own names. There are now 24 separate names for this type of programme with little overlap in names.

This study is based on confusion in the marketplace, with so many names and programme variances. Inasmuch as the institutions market themselves with a reasonably consistent message dealing with the management of product design and development, this research aims to codify current practice, names, and to find a common expectation of graduates knowledge as seen from the industry’s perspective.

1.7.2 The research process and structure

The basic research uses both qualitative surveys as well as comparative studies. The samplings are purposive, as the respondents come from the three subsets, previously noted. The use of the three subsets could be considered triangulation but is rather used to better understand the perspective of each of the three groups.

Subjects will be identified as being in an academic leadership position, whether it be involvement in directing, co-directing, or associate directorship of USA-based programme dealing with the subject matter (see Appendix E). Design leadership will be identified as senior officers in a design-centric organisation whose emphasis on growth is based on design. The term 'design' is used to capture the overall theme and may include organisational, product, service, or design thinking. The alumni chosen will be from one programme within the general area of product design and development management.

1.8 Significance of the Study

The study sheds light on a subject that heretofore has had educators developing curricula based on perceived rather than actual needs. Prior to this work, the selection of appropriate coursework has not been based on the needs of those hiring the graduates. Rather, the coursework has been limited to interpretation of priorities of academics. This internal development of coursework is explored and discussed through interviews with USA leaders of academia in this field. None of those in education leadership interviewed for this study have at the present time, nor have they ever had, independent advisory boards from the business/professional community to guide their efforts.

The general teaching of product design and development management do include some business-related issues, which might include marketing. Of note, is that there are numerous writings referencing the argument of rigour versus relevance in business and marketing. As such, it is expected that as a result of this effort, for the first time,

institutions dealing with the subject of management of product design and development and/or innovation may have a basis for developing curricula.

1.9 Method and Methodological Approach

Underpinning the main body of research for this thesis is a basic data collection of institutions offering this advanced degree, which was accomplished through the use of various databases via an Internet search. It was important to appreciate who is teaching what, and it is critical to appreciate what the 'users' think. 'Users' in this case are the educators, the alumni from one particular institution, and those in senior leadership of design-centric organisations who have management needs in this area. Therefore, primary research is in the form of a questionnaire administered through a telephone interview.

1.10 Required Limitations

Qualifications of institutions for this study are based on an initial search using multiple wording options that include the following terms: master, product, development, innovation, MBA design, MBA/MFA, management, business, integrated, strategy, strategic, strategy and leadership.

Upon course-content review, those that included some combination of design- and/or development- and/or innovation-type classes that were supported by some combination of business-type classes, were given 'spread sheet status'. The review included all courses taught by all institutions.

Additions have been added as work has commenced. At the end of October 2015, within the USA alone, 17 schools grant degrees, with all of them having entered this area since 2000. As of this writing at the end of September 2016, there are 35 worldwide institutions, with 24 individual names, offering the degree, with 17 of those institutions in the USA.

1.11 Concluding Summary

This chapter presents the introduction of the research and the rationale in order to reveal the gap in knowledge known as the theory-practice gap. References to Schön, Ash, Bennis and O'Toole, and others support the gap. The chapter introduces the recognition of 35 programme worldwide, with 17 within the USA, with 24 different individual names. The principle objective is one of aiming for a more balanced and consistent curriculum with greater relevance to industry whilst academically robust.

Chapter 2: Literature Review

2.0 Introduction to the Review

The following literature review includes a broad overview of design management as well as differing points of view for the subject of product design and development management. There are two areas discussed: one from literature relevant to academic teaching and one from industry. The areas include what is taught versus what needs to be learned from the perspective of senior management, as they may not be in accord. The reference to both academic and non-academic publications is important, as whilst one is teaching what they believe is appropriate, the other is hiring based on learned skills; thus the two views may offer a critical contrast. In general terms, the academics' publications may pursue the creation of and the sharing of knowledge whereas industry tends to focus and rely upon applying knowledge. The sections recognise various well-published researchers' basic positions between the following two groups: academics and practitioners and business needs and pedagogy. Databases accessed include Google Scholar, Scopus Document Search, Northwestern University (NU) Library NUcat, Catalogue of the Northwestern University Libraries, and British Library EThOS.

The following figure 1, is a visualisation based on a hypothesis suggesting that 'academia' and 'management' could have consensus, so that course work taught is relevant to industry needs. However, the potential consensus gives way to actual needs based on research that follows, and as will be shown, is in conflict to teaching of subjects academics believe industry wants.

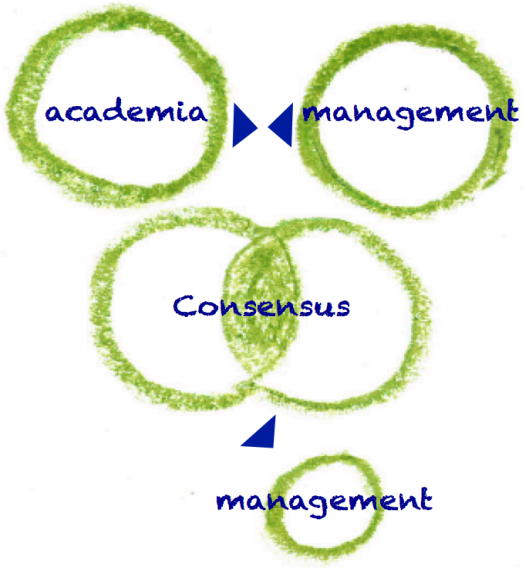


Figure 1: A visualisation of differing points of view between academia and management with a possible consensus, but instead culminating with a management conclusion based on wants and preferences.

2.1 Overview of the Review

The literature search was somewhat restricted due to minimal prior work in the area of pedagogy for the management of design and development. However, there are publications based on similar areas of interest to include business-based master's programme , undergraduate teachings, and conference proceedings with an emphasis on design management. This review also necessarily draws upon a wider literature review than that of design or design management —for example, business management, marketing, as well as design development. The wider review is included, as business education is a component of product design and development management.

Best, (2006: 6), describes 'design management' as, the management of design.

> In its most basic sense, design management is about managing design projects: projects paid for by a client, a business or an organization, and carried on by a designer, the design team or a design consultancy.

She notes the management of discrete design projects is but one aspect, whilst recognising the process is a people-centred, problem-solving process, which is all included under design management. Best (2006: 12) also notes 'the lack of consensus on both the scope and substance of the design management discipline has ensured on-going, rich debate about its continual evolution'.

Topalian (2003) recognised design management and its inclusion with both the project level as well as the corporate level, and that management itself has to not only include the project issues but all of the business/corporate requirements. Gorb (1990) also recognises the pursuit of corporate objectives when he references design management. Turner (2013: 3) notes that design management is not only about the basic practice and a design manager needs to recognise 'the response of individuals to the needs of the business and the contribution they can make to enable design to be used effectively'… and that design management 'is the application of the process of management to the processes of innovation and design'. There is an accord that industry (or 'corporate' as it is referenced in these writings), needs, should be addressed for ultimate success with attention to basic corporate objectives. Cooper *et al.*, (2009) note that the significant contribution to success of an organisation should allow those in design management to rise to a place on the corporate agenda. The Cooper, *et al.,* comments referencing 'rise to…corporate agenda' is interpreted to reflect the importance of design management being as highly regarded as marketing, finance, or operations, as a vital component of organisational structure. Heskett (1989), references the growth of global markets and thus the subject of design management being a preoccupation, based on the fact that design is a key tool for industry competitiveness.

This review draws upon a wider literature range than that of design or design management—for example, business management, marketing, as well as design development.

2.2 Literature on Academic Teaching

There are reports from academic writers of an unidentified gap between the kinds of knowledge held by academics versus the kinds of knowledge held by business-related design practitioners. This is sometimes perceived as a gap between professional knowledge and the demands of real-world practices (Schön 1983), or a theory/practice gap based upon different epistemic stances. Ash (2014;i) states that his "work examines and presents evidence for the existence of a gap in epistemological views between academic and practice marketers".

2.3 Evidence of Issues and Review of 'Divide' Between Academics and Practitioners

There appears to be a conflict between educational interests and business interests regarding student learning supported by Schön (1983).

Educators appear to have a differing point-of-view, as those interviewed rate 10 courses as 'important' and consistent with industry, but do not, with consensus, teach those courses (see Fig 30). Educators' interests include journal publications and presentations at conferences. Attention to publishing is often required to assure tenure positions that lead to more authority and higher positions within academic departments. Within the

American system the ambition for young faculty to achieve tenure and thus promotion allows for a culture of what is commonly known as ‘publish or perish’. Additionally, more publications also support grant applications, which can also lead to more funding. In the USA, these young and/or inexperienced faculty are hired as assistant professors, who may elevate to associate professors and then to full professors. This elevation ultimately culminates in distinguished professors and/or endowed chaired professors. With these promotions come both stature and pay increases.

Based on academics in general, universities appear to care more about their own epistemology, which does not necessarily address the broader need of “practical competency and professional artistry”, according to Schön (1983: vii). He is further convinced that universities are out of touch with the professions and continue to have a “widening rift between the universities and the professions, research and practice, thought and action” (Schön 1983: vii). Kiernan and Ledwith (2014: 219) take a similar position: “Designers need the cognitive skills involved in the execution of the design process, along with skills, such as negotiation, problem solving, …interpersonal skills and project management”, which is either not, or minimally, being taught. Supporting the business need, Gajendar (2014: 220) purports that ‘there is no great link between design practice and design education’. In a paper presented at the 2003 Industrial Designers Society of America, the IDSA National Education Conference, entitled ‘Taking Care of Business: A Model for Raising Business Consciousness Among Design Students’, Gajendar notes there do not seem to be adequate changes taking place in undergraduate design curriculum. He voices concern in that ‘this gap will slow the rise of qualified design professionals, potentially endangering design’s role in leading complex problem-solving as engineering and marketing solidify the lead’ (2003: 1).

Whilst the comments were made in 2003, this early warning and concern continues in current publications. Gajendar puts forth the following model, (Figure 2) for a set of intersections between design and business for educators, believing this will 'set student expectations about design as a complex business process' (2003: 4).

Figure 2: Model proposed by Gajendar (2003) for undergraduate design teaching.

2.3.1 Institutional issues contributing to a divide in the USA

USA programmes in the field of product design and development management are most often driven by institutional and administration issues, which require classes to be taught within the university's dedicated college system. That issue normally translates to a student in the area of product design and development management having to matriculate within three different colleges on campus. The need to take classes at three different colleges is based on a typical product design and development management programme that includes three different disciplines. Those colleges that offer the relevant coursework for the above degree include the college of engineering, the college of business, and the college of art and design. An example would include Carnegie

Mellon University, in the USA and their offering 'Master of Integrated Innovation' programme. The programme as described in their website (www.cmu.edu) includes course work from the colleges of Design; Engineering and Business.

For a student in the programme of product design and development management, some of the courses taught need to be wide but not deep. An example might include 'accounting' whereas those in design and development management will not normally aspire to become certified public accountants (CPA). However, since a student in the discipline of product design and development management may be required to take coursework for the business component of the programme and in an atmosphere of business students and faculty within the business college, the depth requirement will be to the disadvantage of the design and development management student. The disadvantage is the time commitment, which may interfere with all the other learning one needs. For example, in a standard USA MBA programme, a business student will be required to take a semester (10-12 weeks) each, of cost accounting and financial accounting. For one to manage product design and development, one only needs an overview of business subjects, as opposed to an in-depth examination, as would be required in an MBA programme.

Since many graduate schools in the USA require 12 courses for a degree, the students whose desire is to study both business-required classes and product design and development classes will not have the opportunity to experience a broad base of coursework based on the 12 class limits imposed by the institutions themselves. For reference a business master's student will take 12 business related courses. This required course constraint can add to the frustration of those in management if they

hope to hire an individual with both product design and development as well as management education. Whilst this discussion is relevant to a review of some of the issues contributing to the divide between academics and professionals in the world of product design and development management, de Vere*, et al*. (2010) noted that as society changes, traditional engineering curricula are also no longer matching up with current trends, roles, and responsibilities.

In spite of the issues related to institutionally siloed education, Bennis and O'Toole (2005) postulate that business schools themselves are on the wrong track. They claim that for many years, MBA programme enjoyed both institutional respect as well as business-world respect. This respect was accorded to what were deemed to be the best of those programme . However, the authors claim that respect is ill-placed, as the graduates fail to have useful skills, fail as potential leaders, and fail to have had ethical behaviour instilled in them. In spite of the date, 2005, for this journal article, there are no current journal articles that are newer and uncovered, in reviewing the top listing of 100 references of 'Google Scholar' under the search: 'are business schools on the right track'.

2.3.2 Practitioner contributions

The subject matter of a divide between academics and practitioners is relatively well documented. Comments, as noted above, include Ash's work (2014), Bennis and O'Toole (2005), Bartunek and Rynes (2010), and Baron *et al*. (2011), among others. This research is limited specifically to business and marketing, based on prior publications, inasmuch as the general subject includes those areas. This contribution

howver, includes a broader review to include the general subject of product design and development management.

Practitioners may interact with academia in ways other than publications espousing view points. In the USA there is an established standard of universities, colleges, and/or departments having external boards of advisors. Advisors help direct programme content to assure real-world competency and relevancy for students. However, only one master's programme, within the category of product design and development management has a board of advisors. That programme resides at Northwestern University. The point is made because one would normally expect those in academia to address the needs of the graduate student skills that are expected upon entering the work force. Without external guidance, a mismatch can be expected.

2.3.3 Review of factions

In August 2013, the Design Management Institute (DMI) brought 19 educators, 16 professionals, and 14 students together for a workshop in Chicago, USA, for discussions on what DMI noted in a publication entitled 'Redesigning Graduate Education' as; a 'revolution happening in design education…led by students, entrepreneurs and professional and academics that want to break down the traditional silos of education and prepare more empathetic, creative leaders to tomorrow's challenges' (Hardin, *et al.* 2014: 12). This gathering, within the context of higher education in the USA, was the first of its kind

Hardin, *et al.* (2014;14) reviewed comments from that gathering and, coupled with their own research, published the above. They noted the following subjects of importance that they hoped could find clarity at the gathering in Chicago:

1. Define a shared vocabulary around design thinking and design management;
2. Identify educational outcomes that will meet the changing needs of today's design managers;
3. Define the global landscape of graduate schools that teach design thinking to help guide industry and students;
4. Identify an optimal pathway to educational standards for graduate design education; and
5. Determine a role for DMI in the future of design management education (Hardin *et al.* 2014: 13).

The authors developed and published a business curriculum, as shown in Figure 3.

Figure 3: Business curriculum as developed Hardin, Westcott, and Berno 2014.

The curriculum developed, according to the researcher, indicates a skewing toward the 'creative' versus the 'management' of the process. The comment is based on reviewing the above 16 discrete courses and identifying 10 as being 'design centric' versus 6 addressing 'management'. Whilst the subject of the graphic is 'Design Business Curriculum' the author's study designed to identify core course work undertaken for this paper appears to be in conflict. The conflict may be a result of identifying those responsible for the hiring of design management versus those responsible for the programming of teaching materials for this subject matter.

In analysing the professionals invited to the gathering the titles and roles include: Director, design strategy; President of a strategy consultancy; Design Researcher for a major retail establishment; Business development; and Human resources, amongst others. The apparent conflict between the authors study and the DMI results, may be due to the recognition of senior management recommendations for hiring leadership versus existing leadership of design development, both of which appear to have a different point of view.

The summation of the DMI work includes the following comments from Berno, a professor of communication design at Texas State University:

> Today, most graduate education institutions lack agility, and many faculty are surprisingly insulated from—even actively indifferent to—the pace of change in our industry, and its growing relevance outside the realm of its traditional boundaries. It is clear that design thinking is still in its early phase of influence (Hardin et al.. 2014: 19).

The DMI paper has importance, as it attempts to gather insights from a broad audience of mid level practitioners, educators, entrepreneurs, and students.

Schön (1983: 8) when questioning the epistemology of practice and the need to more deeply explore the subject, recognised that "competent practitioners usually know more than they say. They exhibit a kind of knowing-in-practice, most of which is tacit". These thoughts were also expressed by Weightman and McDonagh (2006) when they noted that education was lagging the current design practice by 10 years.

2.3.4 Business school reality

There may be some concern in educating graduate students in the field of product design and development management in combined classes with business students. The concern may be not only the depth of some subjects that may be explored in greater detail by business students than is required for the management of PD&D, but also, as noted by Bennis and O'Toole (2005), the lack of useful skills *and* lack of ethical behaviour exhibited by business graduates.

Whereas design and development professionals recognise their allegiance to not only 'new' but useful and safe products, the MBA students, as noted by the author in their entrepreneurial competitions, generally are more concerned regarding funding and their ability to raise money irrespective of the quality and/or potential success of the concept.

Professor Henry Mintzberg from McGill University, another outspoken critic, criticised the MBA curriculum, suggesting it was less than relevant. In a May 2009 interview with Paul Hemp, a writer for the *Harvard Business Review*, Mintzberg (2009) said the following:

> "You cannot fix the conventional MBA, period. You can't train young people to be managers. So the starting point is nobody should get into any MBA program until they are in management positions and have decent proper experience. And

> then you don't build those programs around a bunch of analytical techniques, although you obviously use those too, they're useful. But you build the program primarily around them learning from their own experience."

Many other deans agreed with this position, as Bennis and O'Toole (2005) noted in an earlier writing, 'How Business Schools Lost Their Way':

> "Business schools are on the wrong track...failing to impart useful skills, failing to prepare leaders, failing to instill norms of ethical behavior, and even failing to lead graduates to good corporate jobs. These criticisms come not just from students, employers, and the media but also from deans of some of America's most prestigious business schools."

Bennis and O'Toole (2005) also acknowledge that genuine reforms remain 'elusive', as they believe the curriculum is the effect, not the cause. The business school model has shifted and, according to Bennis and O'Toole (2005), has now adopted an inappropriate and self-defeating model for achieving academic excellence. The model chosen, rather than measuring the institutions by competency of their graduates, measures institutions by the number of publications based on their research:

> "They have adopted a model of science that uses abstract financial and economic analysis, statistical multiple regressions, and laboratory psychology. Some of the research produced is excellent, but because so little of it is grounded in actual business practices, the focus of graduate business education has become increasingly circumscribed—and less and less relevant to practitioners." (Bennis and O'Toole 2005)

The authors recognise that some of the published research is indeed excellent, but since the research does not reflect actual business practices, it is less relevant to practitioners.

2.4 Rigour Versus Relevance

There appears to be a conflict between educational teaching and business needs. This educational/business conflict is noted as rigour versus relevance. The conflict of rigour

versus relevance occurs at the university level, and especially at research universities, where there is an emphasis on refereed international academic refereed journal papers.

Published writings are based on expanding knowledge. In the USA, most science-based research is funded by government grants, e.g. National Science Foundation; the National Institutes of Health, as well as private companies and non-profits (undsciberkeley.edu). The National Science Foundation, budgeted $6.186 billion in research funding for the year 2016 (American Institute of Physics 2016). Whilst university science-based research labs are the recipients of a majority of these science-based funds, business school funding often comes from external, non-governmental corporate sponsored sources.

Business school research, as opposed to the research coming from the active science laboratories on university campuses tends to include subject matter of interest mainly to academics, with little relevance to the external business audience. This thought is shared in an article in the Academy of Management Journal – In Press; "…as our research methods and techniques have become more sophisticated they have also become increasingly less useful for solving the practical problems that members of organizations face." (Susman *et al.* 1978: 582). The journal article continues on the subject of knowledge transfer and states:

> "A substantial body of evidence suggests that executives typically do not turn to academics or academic research findings in developing management strategies and practices (e.g., Abrahamson, 1996; Mowday, 1997, Porter & McKibbon, 1988). Similarly, researchers rarely turn to practitioners for inspiration in setting their research questions (Sackett & Larson, 1990) or for insight in interpreting their results (Rynes, McNatt & Bretz, 1999). Given this state of affairs, it is hardly surprising that considerable gaps often exist between the normative recommendations of organizational researchers and actual management practices

> in organizations (e.g., Johns, 1993; Miller, Greenwood, & Hinings, 1997; Pfeffer, 1998)." (Rynes, *et al; 2*)

The supporting evidence, based on multiple journal articles indicates a wide gap between the academy and industry as it applies to managerial issues. The managerial issues are brought forth by the researcher as the general subject matter references the need of industry in management as it relates to product design and development.

2.4.1 Brief history of rigour versus relevance

The rigour versus relevance debate first began in the 1950s, according to Ash (2014), but was revisited in 2002, when the Association to Advance Collegiate Schools of Business (AACSB) International—which, according to *The Economist*, is the most widely recognised accrediting agency for business schools (Anon. 2007)—suggested that they (the AACSB) would consider changing their method of evaluating research. The AACSB considered the change following criticism from Jeffrey Pfeffer (from Stanford University) and Christina Fong (from Washington University), each of whom questioned whether the model of teaching in business schools was sustainable (Anon. 2007). In a draft to university administrators, the AACSB suggested that business schools needed to demonstrate the value of their research. They needed to go beyond journal citations and instead base research on the value it brings to the everyday world—and to apply knowledge, not just create it. The AACSB believes they have a responsibility to raise the bar on the validity of research based on the amount of funding given to it.

Research-based campuses recognise, amongst their achievements, the amount of research that is published in established academic journals. *Bloomberg Businessweek* annually publishes 'Full-Time MBA Rankings'. Within their own survey (2012), they include the intellectual capital of the schools, based on the number of articles published by each school's faculty in the top 20 top academic journals. The journals in order of ranking are as follows:

1. Harvard Business Review
2. Strategic Management Journal
3. Accounting Review
4. Academy of Management Journal
5. Production & Operations Management
6. Journal of Business Ethics
7. Journal of Consumer Research
8. Administrative Science Quarterly
9. Journal of Accounting Research
10. Management Science
11. Journal of Marketing Research
12. Journal of Marketing
13. Operations Research
14. Information Systems Research
15. Journal of Finance
16. American Economic Review
17. Review of Financial Studies
18. Marketing Science
19. Journal of Financial Economics
20. Academy of Management Review

The Economist suggests that research is critical, as it answers unasked questions. Research itself is also a means to an end—in not only raising questions and potentially expanding knowledge but also in raising the reputation of the writers themselves (Economist, Aug. 28, 2007). The closed loop of faculty members having to publish, coupled with journals having to print to succeed financially, does become a self-serving enterprise. As also noted by *The Economist*, 20,000 articles are published per year, with most being 'highly qualitative, [and] hypotheses-driven and esoteric' (Economist, Aug. 28, 2007:1). *The Economist* recognises that much of what is written is nothing more than a criticism of what has already been written without bringing forth new knowledge. A reference is made to a paper in the 2006 *Journal of Strategy and Leadership* regarding value: 'Research is not designed with managers' needs in mind, nor is it communicated in the journals they read…For the most part it has become a self-

referential closed system [irrelevant to] corporate performance' (Economist, Aug.28, 2007: 2).

2.4.2 Scientisation of business

It may be easier to understand this need to publish, albeit to other academics, and to raise accreditation of one's institution by the following: Ashe (2014) refers to van Aken (2001), who argues that the 'scientization' of business was following the social science model, where indeed rigour overrode relevance. He referenced Barwise's (2007) comments regarding 'physics envy', where the scientific research process became a model for business schools.

In the scientific model, as named by Bennis *et al.* (2005), there is recognition that business research believes it is equal to the rigour of academic discipline for those dealing in subjects such as chemistry or geology. In wishing to clarify the differences, the authors recognise that business is a profession much like law and/or medicine are professions, and as such, those involved in business research should have their work referred to by professionals in the same manner as the sciences are.

Benis, *et al,* reviewed the evolution of business schools and recognise that most schools want to both educate those going into the fields and also understand that knowledge needs to be created through research. They suggest that for the first half of the century, within the USA, business schools were more like trade schools, as their concentration was on the graduation of those who would be successful practitioners. They noted that professors (teachers) were what we now call 'clinical professors' who by definition are

not on a tenured research track, and referenced that the MIT Sloan School of Management was known as the MIT School of Industrial Management and that for its class in 'production', the school used professional managers from the nearby General Motors facility.[1]

2.4.3. Business/business school issues

In 1959, there was enormous demand for business leadership based on the growth of the US economy, and the Ford and Carnegie foundations clarified such in a report titled 'Higher Education for Business' (Gordon and Howell 1959). The report, published in the *Journal of Business Education*, noted the poor state of business school teaching and theories. In particular, the authors referenced graduate business and stated, 'The majority of students studying for the master's degree in business area enrolled in makeshift programme which are generally unsatisfactory' (Gordon and Howell 1959: 115). The authors opined that at some schools, the academics were 'quacks' and not up to the calibre that they could adequately teach business courses. The foundations' concerns culminated in grant money for education to be given to the top-tier institutions for the sole purpose of asking those schools to act in the same serious manner as the law schools acted. The interpretation of 'serious manner' by the researcher is to act in a

[1] For the purposes of this thesis, 'professor' has several meanings. At USA universities, students refer to their teachers as 'professors'. The word 'professor', however, is titled by the academy itself. Definitions include the following:

Assistant Professor—a title reserved for those early in their teaching career. At Northwestern University, one is appointed an assistant for a three-year term, which may be renewed for a second three-year term.

Associate Professor—a title reserved for those with experience. Associate Professors may or may not be tenured.

Professor—a title reserved for senior faculty. Professors may or may not have tenure.

However, all those who teach may not be awarded the above titles, depending on colleges within a university. Some colleges use the title 'lecturer' rather than 'professor'.

more scholarly and professional manner, based on evidence, case histories and practical knowledge.

That directive resulted in most of the 24, USA top-tier business schools offering a more stringent curriculum, which began a change in focus and objective. That change led to the demand for scientific research. While the schools did not want to go back to the original trade-school mentality, they were now moving toward scientific rigour. Bennis and O'Toole (2005) note the following:

> "Business school professors using the scientific approach often begin with data that they use to test a hypothesis by applying such tools as regression analysis. Instead of entering the world of business, professors set up simulations (hypothetical portfolios of R&D projects, for instance) to see how people might behave in what amounts to a laboratory experiment. In some instances those methods are useful, necessary, and enlightening. But because they are at arm's length from actual practice, they often fail to reflect the way business works in real life…A renowned CEO doubtless speaks for many, when he labels academic publishing a 'vast wasteland' from the point of view of business practitioners…Today it is possible to find tenured professors of management who have never set foot inside a real business except as customers". (p.2)

According to the Gordon and Howell report, top-ranked business schools of the day would never hire, nor would they ever promote into a tenure-track, faculty whose backgrounds might have included a distinguished career in managing a major manufacturing facility. The business schools themselves took a course of action, attempting to replicate the academic excellence of science-based programme and, as noted above, were lured into what is noted above as 'physics envy'.

In science, the term 'physics envy' is used to criticise a tendency (perceived or real) of the softer sciences and liberal arts in trying to obtain mathematical expressions of their scientific robustness and fundamental concepts in an attempt to move them closer to harder sciences, particularly physics (Clarke and Primo 2012). The result is that

business professors who study the subject of business from a distance may believe it to be a science. Not surprisingly, those who climb to the top of academia and dominate these faculties do so by reputation in publication. It is the same people who tend to take responsibility for curriculum, based on their own success in published research, and as such, the curriculum is often scientifically oriented.

Of some concern is Bennis and O'Toole's (2005) recognition that the business schools have dramatically changed for the worst since the mid-80s. The authors reflect on a case where a highly rated business school was reviewing a curriculum change dealing with a multidisciplinary course based on a global enterprise. The new course was rejected but not because of any pedagogical reasons; rather, it was rejected because, as one faculty member put it, 'we are not qualified to teach it'. The Bennis and O'Toole comment was based on what they believed was irrational, as subject matter for teaching a global enterprise course should have been comfortable teaching matter, for a business school professor.

According to Bennis and O'Toole (2005), employers report that business school graduates lack the basic skills that are so badly needed. Those who are teaching have spent little to no time as managers or consultants and know more about academic publishing than about the issues taking place in the workplace.

Based on the above, there exists in-house education amongst corporations. The global corporation Proctor & Gamble (P&G) is reluctant to allow formal training by non-company employees. This thought was noted during an interview for the master's degree in Product Design and Development Management at Northwestern University.

Other institutions with a policy of in-house training include Motorola, McDonald's, General Electric (GE), Nike, Disney, Apple, Pixar, and Dell. These corporations have established in-house 'universities' (see Figure 4). As expected, some of the education addresses specific corporate educational needs. Many corporate educational facilities are 'stand-alone' campuses and/or dedicated buildings.

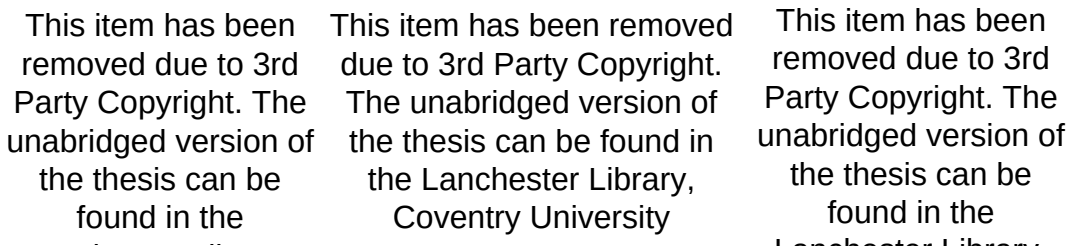


Figure 4: Images of corporate campuses (Ganesh 2008, Tuder 2014, and Disney n.d., respectively)

The issue of corporate education was recognised in a 2013 *Forbes* article, with the author stating that 'academia really is standing on a cliff' (Guthrie 2013: 1). Within the article, reference is made to the two oldest and probably the most famous corporate universities: Hamburger University by McDonald's, and GE's Crotonville. Launch dates were 1962 for McDonald's and 1956 for GE, which is the oldest corporate university in the USA. According to Guthrie (2013), corporations are solving some of the problems by educating their own employees: "Many corporations are creating their own internal universities because they feel business schools have failed at training the managers and leaders needed to run their companies"(n.p.). The needs include educating students in creativity, flexibility, innovation, and adaptability.

Bennis and O'Toole (2005) suggest they are not advocating a return to the trade-school mentality of the business school, but rather the challenge is to restore balance to achieve

both rigour and relevance to the business school. They call it ‘a dirty little secret’ that todays’ best business school faculty have a greater interest in research. That interest results in increased standing in their careers with little interest in the needs of their ultimate stakeholders, who are the businesses they hope to place their students in. Bennis and O’Toole (2005) conclude in their writing that ‘the problem is not that business schools have embraced scientific rigour but that they have forsaken other forms of knowledge’(p.8).

A similar situation exists in the field of organisational science. Rynes, *et al.* (2001) also make note that research methods are now more sophisticated, but unfortunately, with this new sophistication, it appears that the usefulness has been diminished. Whilst the subject matter specifically concentrating on organisational science seems distant from the effort at hand, which is a better understanding of coursework for all those who teach within the field of product design and development management, organisational science is a component of many programmes . Specifically, Rynes *et al.* (2001) recognise that the techniques educators are using for the resolution of everyday practical problems may in fact be too complex. The authors also recognise that they are talking to themselves as academics. They reference the fact that on an annual basis, they have a conference, followed by their normal activities, which includes reviewing each other’s papers. That review ultimately includes the publication of those papers so that they can complete the loop. Once again, in the following year, they have another conference and reference the papers they have written, reviewed, and published.

Business executives do not refer to academia for management direction in either strategy or actual practice, and similar comments have been credited to others in writings by Ash (2014), who references Abramson (1996), Mowday (1997), and Porter

and McKibbon (1988). Based on the above, researchers rarely interact with practitioners for insight, inspiration, or deeper understanding and reference (Sackett and Larson 1990 and Rynes, *et al.,* 1999). The recognition that this sets up a considerable gap between those in organisational research and those in management is referenced by others: Johns (1993), Miller, *et al.,* (1997), and Pfeffer (1998). Each of these authors (as well as others before them) has recognised the gap between the reality of management practice and those involved in organisation research.

According to Rynes *et al*. (2001), this gap between researcher and practitioner is not restricted to the business sciences as taught in business schools. It can also be attributed to the pure sciences and the relationships between researchers and practitioners (Glaser, *et al.,* 1983, Leontif 1982, and Rogers 1995). Rynes *et al*., (2001) cite Mosteller (1981), who reported that scurvy, which is widely known to seafarers, had a cure, but it took 200 years for that cure to be recognised by the Royal Navy for adoption. This study, as have other studies, recognises there is a research-practice gap and that this gap resides between academia and practitioners and has been going on for some period of time. According to Rynes *et al.,* (2001), who reference Shrivastava and Mitroff (1984) and Thomas and Tymon (1982), both sides of the discussion think differently regarding information they believe to be valid for action, as they have different frames of reference. Others have recognised the differences in thinking between the two groups regarding influences, goals, and timeframes for resolutions of the problems and actions to be taken.

In a review of the literature on research utilisation, Beyer and Trice (1982: 608) note that ‘the most persistent observation…is that researchers and users belong to separate

communities with very different values and ideologies and that these differences impede utilization'. Thus, despite long-standing concerns about the limited research-practice interface (Campbell *et al.*. 1982 and Susman and Evered 1978), many observers are sceptical about whether closer relationships are possible (Cummings 1990, Garland 1999, Hakel 1994, and Oviatt and Miller 1989) or even desirable (Earley 1999, Fagenson-Eland 1999, and Gillespie 1991).

2.4.4 Academic values/business values

The rigour versus relevance argument has been revisited since the early 2000s. The argument has been cited by Ash (2014) with reference to Stanton (2006) regarding the teaching of marketing and academic research and including citations from Baker and Holt (2004), Koch (1997), McKenzie *et al.*, (2000), Grey (2001), Augier and March (2007), and Clinebell (2008).

Whilst not specific to the rigour versus relevance argument, Schön (1983: vii) adds relevance to the discussion: 'We are in need of inquiry into the epistemology of practice… competent practitioners usually know more than they say. They exhibit a kind of knowing-in-practice, most of which is tacit'. That need for epistemology of practice inquiry continues to exist today. As supported by Bartunek *et al.*, (2010) as well as Baron *et al.*, (2011), and noted by Ash (2014: 2), the arguments supporting the divide between academic values and business values "emerge from the academy's need to publish and arguments are made that this creates a perverse incentive, prioritising rigour over relevance".

Not all business schools suffer from the specific focus of faculty 'talking to themselves'. Harvard Business School is an example of an institution having found a formula that satisfies both academic values and business values. Harvard is devoted to case studies that are published in a monthly magazine: *Harvard Business Review* (HBR*)*. HBR counters the notion that academic values and business values do not have a common bind. To assure the magazine's success, both academics and practitioners are necessary to fulfilling the writing needs and assuring the business community's knowledge is enhanced. A review of a typical issue (e.g., 2015 December) reveals seven articles by academics and four articles by practitioners. It is of particular interest that the seven articles authored by academics are all based on studies of business units.

This strategy of academics studying and writing about business issues and of business professionals writing about their own issues, supported by internal research, results in a widely read publication with multiple reprinted articles that are used for teaching. The circulation of the magazine in 2014 was 292,954. However, the number of cases sold equalled 11,991,870 (Harvard Business School Statistics). The point is made regarding cases sold, as those 'cases sold' are purchased and used by teaching institutions.

The subject of academic and practitioner values is being brought forth again, as Rynes *et al.,* (2001) recognise that in spite of the inordinate degree of work already reviewed in this field, the timing may be right for another re-examination. They cite two reasons for reviewing this subject one more time:

1. The authors believe that due to economic and political conditions, academics and practitioners are now more receptive to learn from one another.

2. The authors believe the discussion has been based on anecdotal evidence and now needs to move forward with solid empirical data.

Researching business is messy, according to Wrigley and Bucolo (2011), as it includes lots of human activity with lots of judgments. Those judgments depend on variables, as one may not have all the data and/or the data may not be coherent for the time required to make the decision. These issues, and many more, are not easily modelled nor can scientific experiments be developed and validated for them.

2.5 Pedagogical Review Regarding 'Design'

For this review of product design and development management type programme , one should reflect on the word 'design' and its meaning to help clarify the word and the range of usage from a pedagogical point of view. It is of importance, as there are and will be in this paper many references to 'design'.

According to Dym, *et al.,* (2005: 103), 'Design is widely considered to be the central or distinguishing activity of engineering'. They recognise that in most engineering curricula, the first two years are dedicated to the basic sciences and serve as the foundation for advanced scientific concepts. That foundation often culminates in a team-based senior-thesis capstone design-based project. The preliminary research confirms this: On a master's level for design and development management type programme worldwide, thesis/capstone classes are present in 31 out of 35 programmes.

Evans (1985) offers another position on design in engineering programme , noting that while design matters, the subject itself is a bit controversial. However, when accreditation is needed, design is most often referenced; albeit, 'Even "design" faculty—those often segregated from 'analysis' faculty by the courses they teach—have trouble articulating this elusive creature called design' (Dym *et al.*, 2005: 103). The memorable theme from Dym *et al.,* is that design is central to engineering and is being talked about in engineering curricula. They go on to note that whilst there is talk, very little is actually done other than talk.

Since that time, there has been a major change in the USA, both in undergraduate as well as graduate programme . At the graduate level, there are now 17 universities dedicated to the general subject of engineering/design/development management. Of those, 15 have an integration capstone course requiring a design-centric approach. Capstone is defined as a dedicated course devoted to referencing various subject matter as an integrated unit. In their musings on design thinking, and in an attempt to try to appreciate what the word 'design' means, Dym and Little (2003) note that the definition of design, while not restricted to-art and-design schools, was, however, centred on those institutions. The word and/or subject of 'design', by itself, was not within the taxonomy of an engineering school, albeit they reference the more complex 'engineering design' was.

Senior thesis (final integration) projects often deal with design-related issues, with those being 'engineering design', according to Dym *et al.* (2005). The authors attempt to appreciate why the subject is so difficult to teach and why it appears to be so complex

when they believe that on the surface, it is a 'fascinating' subject to most. Dym *et al.,* (2005: 104) respond with the following statement:

> "Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients' objectives or users' needs while satisfying a specified set of constraints".

They then characterise skills often associated with good designers, namely, the ability to:

- "tolerate ambiguity that shows up in viewing design as inquiry or as an iterative loop of divergent-convergent thinking,
- maintain sight of the big picture by including systems thinking and systems design,
- handle uncertainty,
- make decisions, and
- think as part of a team in a social process.
- Think and communicate in the several languages of design" (2005: 104)

When referencing 'several languages' the authors refer to sketching, engineering drawings, and computer programmes. Whilst the above is dedicated to undergraduate teaching, the skills might be appropriate for master's coursework in product design and development management.

Dym and Little (2003 p.104) posit that 'asking questions emerges as a beginning step of any design project or class in the problem definition phase…Questioning is clearly an

integral part of design'. They also recognise that in today's engineering curriculum, most students are given problems with absolute answers, based on proven principles for solutions. They then go on to recognise 'design educators already argue that the tools and techniques used to assist designers' creativity are…ways of asking questions, and presenting and viewing the answers to those questions as the design process unfolds' (Dym and Little 2003: 104). They continue by drawing upon Aristotle:

> Aristotle proposed that the kinds of questions we ask are as many as the kinds of things which we know'. In other words, knowledge resides in the questions that can be asked and the answers that can be provided…Aristotle's ordering, thus reveals a procedure, which constitutes the inquiry process in an epistemological context. (Dym and Little 2003: 104)

They recognise that asking questions is the beginning step of any design problem but are concerned that in engineering curriculum systematic questioning is the norm whereas "proven principles are applied to analyse a problem to reach verifiable… solutions" (2003: 104).

Within the design process, one looks for the possibilities that can be created from facts; Dym et al., (2005) explain, "Questions that are asked in design situations, however, often operate under a diametrically opposite premise: for any given question, there exist multiple alternative known answers, regardless of being true or false, as well as multiple unknown possible answers" (105).

Dym and Little (2003) suggest, 'effective inquiry in design thinking includes both a convergent component of building to asking deep reasoning questions by systematically asking lower-level, convergent questions, and a divergent component in which generative design questions are asked to create the concepts on which the convergent

component can act.' They personalise the thought that divergent questions and answers is part of design thinking and is not performed well within an engineering teaching environment. This method of inquiry, as a teaching foundation, might support inclusion into a master's programme.

According to Dym, *et al.* (ibid), the design process is full of ambiguity, and as a result, or because of it, one is continuously negotiating with clients, leadership, teams and/or partners. That ambiguity is in itself a critical component of the mechanism for the deeper understanding of design. Dym and Little (2003) emphasise the need for communication skills teaching. This teaching will assure designers can function—not as sole practitioners but rather in a true collaborative role within a group. Design being ambiguous does not unto itself make a person collaborative. The Dym and Little paper explores organisational design and behaviour and recognises the value of applying MBTI to the formation of student engineering design teams.

Probability theory is also reviewed so that one can 'demonstrate the proposal of application of decision trees to design concept selection', as used by Dym and Little, supports the proposal that probability and statistics (Wood 2004: 107) should be a part of design curricula and recognises that uncertainty and design of experiments should also be part of design education. It should be noted that courses in probability and statistics are currently taught in product design and development curricula.

While the field of product development is relatively young, it is also changing rapidly. Those changes are due to emerging trends in innovation as well as overall changes in the world and in the world economies, according to Jacoby and Baelus (2013).

However, the authors support that the basic approach to product development, to include services, still remains much the same irrespective of one's area of expertise or need. The authors make a point that 'every design cycle has an analytical and a synthesis related component' (Jacoby and Baelus 2013: 654).

Jacoby and Baelus (2013) built on the work of Buijs (2008) as well as Braet and Verhaert (2007), working with academia and industry, defined a masters programme approach. The approach consisted of four areas of concentration: (1) strategic design, (2) interaction design, (3) advanced product design, and (4) advanced systems design. They delineate the process into two major components. They call those components the front end of innovation (FEI) and new product development (NPD) in which the products are actually developed. In their process, NPD culminates in production and launch. As illustrated in Figure 5, the FEI component consists of two basic components: (1) the search fields and opportunities section and (2) the idea generation component, which includes products and services. The NPD component includes design and development, and within that category are system design and product/service design.

Figure 5: A Process Model for product development (Jacoby and Baelus 2013: 655)

The rationale for the above is that the systems solutions component responds to the critical and primary development issues, while the product design solutions cover the materialisation and actual physical form of the product. System design allows for a complex problem to be divided into manageable components. For the strategic design major, the focus is on the front end of innovation, covering product definition. The deliverable for this major is simply the definition of the product or the service to be delivered. The system design major (see Figure 6) is all about the new product development phase, with the focus on the system level.

Figure 6: A Process Model for system design (Jacoby and Baelus 2013: 656)

According to Jacoby and Baelus (2013), the product design and interaction design majors (see Figure 7) focus on the materialisation of development. The deliverables for this major include the identification of production techniques, general construction issues, usability of the product, and appearance. Recognition is made that the actual deliverable could differ between physical products and services.

Figure 7: A Process Model for product design and interaction design (Jacoby and Baelus 2013)

The authors recognised the need for the new curriculum and the variance, as they claim firms that are involved in the field of innovation have different needs for different employers—for example, the larger the firm, the greater the need for variance of competencies (Jacoby and Baelus 2013). The paper also recognises the need for managers of innovation to support these processes, albeit they may be more involved in strategy rather than the actual process of design and development. Jacoby and Baelus make a point in also noting that typical design skills may not be necessary in the FEI, but they recognise that design thinking as well as visualisation competencies add considerable value.

The authors note that the front-end divergent and convergent thinking requirement is no different in that regard, than the rest of the innovation cycle. The programme is a four-semester programme and is by the authors' definition a design project-oriented approach (Jacoby and Baelus 2013). In broad terms, there is a product definition level, a system design level, and a product design level. The product definition level leads to a proposal of a new idea, supported by market and technology research. The purpose is to assure an added value for all within the stakeholder value chain.

The front end can be seen with a similar but different lens. Cagen and Vogel (2012) reference social, economic, and technological (SET) factors, as illustrated in Figure 8, as the combination for identifying product opportunities.

Figure 8: SET factors leading to product opportunity gaps (POGs) (Cagen and Vogel 2012: 21)

For system-level design, the focus is on variants of the product or service within the total system. It is noted as a system because it consists of various elements. The product design level is that phase that results in the totality of the final design and includes materials, manufacturing, and overall design. Cagen and Vogel (2012) admit to having difficulty managing these disparate programme ; the paper is about a 'plan' for this type of programme. They believe the issue of timing of milestones, which are illustrated in Figure 9 and are incompatible with each other, will cause the difficulty.

Figure 9: Milestone timing (Jacoby and Baelus 2013)

Referencing some of the above allows for a better appreciation of the many variables that might be included in the exploration of subjects for a master's in product design and development management.

2.5.1 Appreciation of variables

Understanding the methods used could also be a significant learning. Systematic questioning, with the expectation of multiple answers (which all are a result of divergent questioning) becomes the basic 'build' component. Convergent directions and the continuous exploration of the process follows that 'build'. It is that process that needs to be explored further.

Building a case for using probability theory to 'demonstrate the proposal of application of decision trees to design concept selection', Dym and Little (2003: 107) support the proposal that probability and statistics (Wood 2004) should (or could) be a part of the curriculum and recognises that uncertainty and design of experiments should also be part of design education. Dym and Little (2003) also emphasise, 'To an increasing

degree, design is being recognised and taught as a team process with multiple socio-technological dimensions'. They discuss Rittel, an early researcher in the design sciences, who emphasised that the early stages of the design process are 'inherently argumentative' (Dym and Little 2003). This approach requires the designer to continually raise questions. This is contrary to the Aristotelian approach … and 'argues with others over the advantages and disadvantages of alternative responses' (Dym and Little 2003).

The design process is full of ambiguity as noted in the review. As a result, or perhaps because of it, one is continuously negotiating. However, ambiguity is in itself a critical component of the mechanism for the deeper understanding of design. By referencing both Minneman (1991: 107) and Dym and Little (2003) the need for communication skills, 'as one is continuously negotiating', appears to be a need, and learning these skills will assure that designers can function in a true collaborative role within a group.

2.5.2 Thoughts on sketching and design thinking

Sketching may be viewed as another language for 'design solutions' as well as for exploring and highlighting possibilities, according to Dym and Little (2003). The use of the phrase 'another language' relates to the growing popularity and use of computer solid modelling as practiced by engineers. Sketching, irrespective of computer software opportunities, is the language designers speak. With that competency, one has the ability to explore various outcomes that cannot be explored via the written word or through computer programme with as much detail, as much nuance, as many iterations and/or with as much emotion. A reference is made that 'Designers think about design

processes when they *begin* to sketch and draw the object they are designing' (Dym et al.. 2005: 108.) and that 'sketching also provides another language or representation that can be used to store design solutions' (109).

This quest to first identify a problem, based on human-centred design, and of understanding the ultimate end user, followed by sketching concepts, evaluating and iteration, is a classic design methodology. It is also of interest that some writers recognise that sketching can have a positive impact on designed products. Schutze, Sachse, and Romer (2003) confirmed that 'sketching can have a positive impact on the quality of the designed solution and on the individual experience of the design'. These writings indicate that sketching for ideation is a breakthrough in engineering design education. In 2003, Schutze *et al*., confirmed that "sketching can have a positive impact on the quality of the designed solution and on the individual experience of the design" (ibid:89).

However, the thought of sketching for ideation being a new(er) concept, is contrary to the USA practice amongst consultancies or corporate offices that specialise in product design and development. Designers trained in art-and-design colleges have been co-existing and collaborating with their engineering-trained counterparts since the early 1970s. In that collaborative environment, the concept of sketching iterations has and continues to be the standard.[2]

[2] In the USA, classic 'design' studios are founded by industrial designers. As part of the education within the USA system, coursework extends beyond 'design' programme and includes manufacturing methods. Since solid modelling is taught in all programme, the designers are all skilled in 'shelling' a housing and in integrating internal mechanisms. However they normally do not receive any engineering coursework that might include mechanics. As such, design studios have to rely on mechanical and/or electrical engineers. Those disciplines are either internal or external, but in all cases, coexisting is mandatory for completion of projects, and sketching skills are of great importance for communicating concepts.

2.5.3 Concept for teaching new product design and development

Rather than limiting the teaching of basic technical skills of industrial design that would normally concentrate on human-centred design and basic design skills, curricula have been developed by Wrigley and Bucolo (2011) supporting a case for commercialization. They appreciate that students must develop a sense of end-user needs that would include ergonomics as well as manufacturing processes within the design process. Additionally, they introduce coursework that employs product strategy for consumer acceptance and expectations. This is combined with the recognition of the requirement for corporate financial and marketing objectives. As such, they introduce programme dealing with intellectual property, market opportunities, competitor analysis, and investor issues that would normally include economics and finance. They believe their approach to teaching this theory and its value to designers are novel. Whilst they do believe their approach is novel, the master of product design and development management at Northwestern University includes all of the above coursework.

Wrigley and Bucolo (2011) believe the process of new product development (NPD; see Figures 10 and 11) has been taught within industrial design programmes , and they believe this teaching to be a worldwide standard. They further postulate that this theory resides in marketing programmes within business schools and/or business curricula and, as such, becomes an elective for design students.

Figure 10: New product development graph (Tailor and Tailor n.d.)

Figure 11: New product development graph (Ulrich and Eppinger 2012: 37)

The authors reference Kotler (2003), Kahn (2001), and Bruce and Besant (2002) in noting that the fields of marketing and design are key contributors to the new product development process and had been previously established as such. However, the questions, for the authors, are these: 'Can the statement work the other way around? How does new product development contribute to design? More specifically industrial design?' (Wrigley and Bucolo 2011: 1). They reference Veryzer and de Mozota (2005) in further investigation of the link between marketing, business, and industrial design, with each as a critical component of the development process, and in that exploration needs to be done to assure effective management.

Wrigley and Bucolo (2011) are in agreement with Annacchino (2007), who states, 'globally, new product development is an essential part of a healthy growing economy

and business structure' and the authors believe few business activities are recognised for any promise of positive outcomes from their own NPD process. This thought appears to be in conflict to the design value index, as developed by the Design Management Institute (DMI), which claims that 'design driven companies outperformed the Standard and Poor's index over a period of ten years by 228%' (Westcott 2014). Wrigley and Bucolo (2011) also note that decision-makers in NPD have to address five key issues:

1. What to launch?
2. Where to launch?
3. When to launch?
4. How to launch?
5. Why they are launching?

As such, the authors recognise that a more complete education has to be taught to designers and has to be taught in the beginning of the development cycle.

The Wrigley and Bucolo (2011) business case itself requires an understanding of the following:

End-user needs	Strategy	IP strategy	Financial requirements for funding
Market sizing	Marketing strategy	IP protection	Risk versus return

In addition to the above, formal class work was developed by Wrigley and Bucolo (2011) and included an NPD overview as well as marketing, financials/funding—costing/ROI, manufacturing, and the business case pitch (communications). The reader has to be reminded in this case that the above NPD coursework was directed at industrial design students in an undergraduate curriculum, but it could be considered for master's level work.

2.5.4. Reflections on pedagogical writings

Whilst there is a reasonable amount of writing referencing coursework for the general subject of engineering design, as well as a plethora of general writings on managerial coursework, there are limited publications on coursework for product design and development management. When one reflects on the variety of master's programme that exist, one recognises the lack of standardised course work.

There is a school of thought based on replicating professional practice, noted earlier with discussions on rigour vs. relevance. Of concern to those with this belief is that educational theories do not form and/or may not be the basis of design education. One perspective is as follows: 'The measure of learning is generally equated with the evaluation of the product of designing, rather than on what might be considered a learning increment' (Oxman 1999). Oxman goes on to argue, 'as a consequence there presently exists a lack of educational theories of learning which function as an underpinning of design education.' The Oxman paper was written in 1999, and in later years, de Vere, *et al.,* (2010) presented a paper dealing with educational theories of

learning that clearly shows a dramatic shift from Oxman's point-of-view. The shift is specific to educational theory for those teaching in the design-engineering field.

De Vere *et al.*, (2010) recognise a greater focus on sustainable design, socially responsible design, and designing for global need. They recognise that these needs should be met with new skills to include more creative design and a human-centred approach. The authors recognise that these attributes are not present within classic engineering curricula as currently taught. They make no comment if this is also true for classic design curricula. They suggest that the new product design engineer (PDE) reflect a greater integration of industrial design and mechanical engineering. Nevertheless, the authors argue that 'product development teams require an integrated multidisciplinary approach'. They put forth that a new curriculum needs to be addressed to assure interdisciplinary skills, coupled with creativity, and integrated into engineering design methods.

Those who actively practice and/or teach 'design' recognise that in current studio strategies, the integration of designer and engineer is not only commonplace but required for potential success. That view is supported by Cross (2000), who discussed the need for integration of industrial design and engineering, leading to the conclusion that successful design requires that integration within competitive consumer markets. In the reference of Cross by de Vere *et al.,* (2010), and the recognition that the principle idea of PD&D is a collaborative effort between engineers and industrial designers, a delineation is made between the disciplines: 'designers and design engineers'. De Vere et al., (2010) continue in the area of collaboration and suggest that consultancies as well

as internal PD&D departments 'now require flexible and adaptable engineers who can operate effectively in global multidisciplinary environments'.

The historical references are critically important, as they draw attention to an important point:

> Engineering appears to be at a turning point… evolving… to provide clients with technical advice…to serve…in a socially responsible manner…and that an educational approach is needed…as it is no longer sufficient nor even practical to cram technical knowledge in the hope that it will enable them to do whatever engineering test is required…throughout their careers. (Beder 1999)

An evolution appears to be taking place and is referenced in the 'Educating Engineers for a Changing Australia' report developed by the Institution of Engineers, Australia, (1996). In that report, there was the recognition for 'a high level of understanding of the broad human, economic and environmental consequences of the professional tasks engineers have to face today'. The subject originated by the 'Standards and Routes to Registration' accreditation developed by the Engineering Counsel, UK, which noted that universities are required to confirm that their graduates have 'the ability to be creative and innovative' (Engineering Counsel 1997). In spite of the report, others continue their concern that changes have to be made in education. Baillie and Walker (1998) note, 'it is now up to the educational institutions to discover ways of fostering creativity in students'. As de Vere *et al.,* (2010: 2) observe, they do not see

> many instances of new or innovative engineering curriculum or indeed that engineering education is adapting to address the needs of a rapidly changing world, [which] reveals a deep suspicion within the engineering community of curricula that focuses on design and creativity, or seeks to move beyond the science-based theory model.

Others, as referenced by Dym et al.. (2005), opine that the concentration of engineering training continues to focus on the science of engineering rather than on the creative

side: ‘Engineering is, by nature, a creative endeavour, but many engineering colleges fail to address this, and end up training engineers for technological task completion’, not necessarily the ability to identify opportunities (Pappas 2002).

The marketing description, as created for Northwestern University (2016), and noted within one of their Engineering School brochures, is as follows:

> “We do more than educate great engineers, we empower our students to become whole-brain engineers. This means integrating the element of left brain thinking-analysis, logic, synthesis, and math—with the kind of high-level right-brain thinking that fosters intuition, metaphorical thought and, creative problem solving. To lead effectively, you must master both.
>
> Just as we empower you with whole-brain thinking, we inspire you to do great things with your life. To change the world for the better in material ways. To influence others to do the same. To lead organizations, and communities. To have an impact not only with what you make, but with how you think.” (n.p.)

The above appears to be in concert with de Vere *et al*., (2010) comments. As is noted, they too have responded to their engineering design programme needs through the integration of ‘designerly ways’. That comment supports the thoughts of Dym et al., (2005), who note, ‘The purpose of engineering education is to graduate engineers who can design’.

De Vere *et al.,* (2010) refer to the collaboration between the Glasgow School of Art’s Industrial Design Department and the University of Glasgow Department of Mechanical Engineering. That collaboration was followed by the University of Strathclyde (Scotland) in developing a new curriculum in the late 1980s. The changes, as suggested by the author, were based on the writings of Schön in ‘Educating the Reflective Practitioner’ and also recognised the demand for integration and understanding between

engineering and design. The undergraduate programme referenced by de Vere et al., (2010) was commended by the Institution of Engineers Australia (IEAust) (2008: 2) for its 'innovative' education model. Clearly, this was driven by 'the aims of IEAust in 'Engineering Design: A National Asset', which asserts that synergistic attitudes and relationships must be fostered between engineering designers and industrial designers, who are natural professional companions'.

De Vere references the USA perspective and the scholarly/teaching between engineering designers and industrial designers. In the USA, design engineers reside under the 'mechanical engineering' departments, whilst industrial designers generally are schooled within the colleges of 'art and design'. Those schools, or colleges, often include graphic design, sculpture, painting, photography, new media, art history, and art education—albeit there are variants to those programme ; however, the preceding list is the exact programme at one of the largest state institutions, the University of Illinois. The engineering colleges and the colleges of art and design within some USA universities to include the University of Illinois, are on opposite ends of campus, as the original architects never saw a connection or a relationship.

Another view is put forth by Cross (2001: 3):

> Scientist[s] problem-solve by analyses whereas designers problem-solve by synthesis…the designers approach is user and solution focused, frequently intuitive and divergent; whereas convergence is at the core of the engineering process. Engineering education must learn from design pedagogy if engineering students are to develop creative problem solving skills.

The following figure 12, was developed by the author as a visual descriptor for convergent thinking based on exploration culminating in final development. It is used in

a course titled ‘Overview of the Process of Product Design and Development’, which is taught in the Master of Product Design and Development Management programme at Northwestern University.

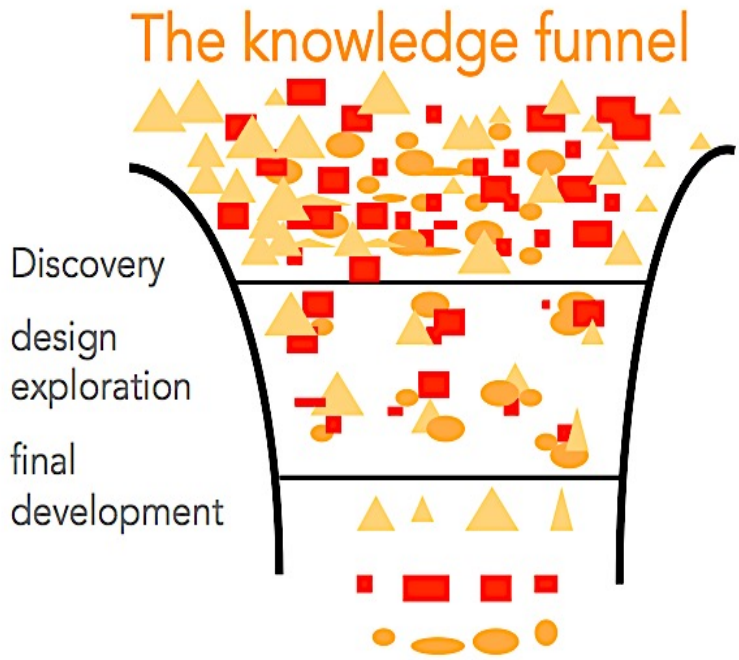


Figure 12: The knowledge funnel

It should also be noted from the preliminary research that of the 35 institutions studied for their graduate work in product design and development management, 14 have a course in industrial design or industrial design engineering. When exploring the subject of design pedagogy and project-based learning, Dym et al., (2005: 111) note: ‘Capstone courses are increasingly referred to as providing design or project experiences, thus exemplifying Kolb’s model of experiential learning (Kolb, 1984: 109); the paper goes on to state, ‘globally distributed teams consistently produced better documentation of both their products and their processes’. In reviewing these statements, it is interpreted that course opportunities that are not being taught formally in any of the 35 programmes

dedicated to the subject could include sketching as well as the value of ambiguity in not defining solutions but in assuring exploration for the understanding of the problem.

In analysing the main components of some of the above writings and reducing it to specific and potential coursework, the following were identified, based on the above review, as having value but not necessarily being taught by a number of institutions, albeit some of the coursework is taught by many:

- Capstone
- Design
- Design Process
- Probability and Statistics/Design of Experiments
- Decision Analyses
- Team Process
- Communications
- Organisational Behaviour using Myers-Briggs.
- Conflict Understanding and Resolution.
- Sketching
- Globalisation

2.5.5 Design-based education and design-based practice

There are now a number of writings dealing with the relevancy of design education and real-world needs. Questioning if design education is adequately preparing product designers and specifically those gradating from institutions in Ireland, Kiernan and

Ledwith (2014) recognise the evolution of design has now grown beyond pure aesthetics and includes service, branding, business strategy, and technology (Kiernan and Ledwith 2014; Maciver and O'Driscoll 2010). Kiernan and Ledwith (2014) also recognise these boundaries between the disciplines are disappearing. They refer to Weightman and McDonagh (2006) and Wohlfarth (2002), who recognise designers need broader skills that go beyond the technical skills that design schools are required to teach in order for their graduates to enter the field of 'design'. They recognise 'the shift is towards user-centred design, strategic planning, innovative product development, sustainable product development and interdisciplinary collaboration (Beucker 2004; Grasso and Martenelli 2007; Kolko 2015b)'. The authors also draw upon Dell'Era *et al.*, 2010, Perks *et al*., 2005, and Veryzer and de Mozata 2005 regarding new product development, suggesting that designers are at the centre of design-driven innovation, providing leadership and ideas.

The need for designers to have cognitive skills that include negotiation and problem-solving in addition to project management skills is written about by Lewis and Bonollo (2002) and Burns et al.. (2006) who note that designers are being used 'more strategically across their business to help them grow and compete more successfully in global markets'. Whilst those reviews have been put forth from an undergraduate point of view, there was little to no addressing the need at a graduate point of view until 2000 when it was recognized at Northwestern University in their belief that no programmes existed to fill this void. In that year, the Master of Product Design and Development programme at Northwestern University began teaching interdisciplinary studies for those professionals practising in the field.

A study, concentrated on postgraduate education of designers, either from or those who had studied design in Ireland by Kiernan and Ledwith (2014) was published. Thirty-six per cent of those graduate students were from outside the country. The survey included 251 graduates who went on to post-graduate education. The growth in numbers of those in post-graduate education was based on what Ireland perceived as its' loss of its manufacturing base, thus a loss in needs for designers. As such, graduates felt the need for broader education to ensure potential work opportunities. Post-graduate education courses that were taken by design graduates ranged from education coursework (in order to teach engineering and specifically medical and biomedical engineering) to advanced classes in product design. From 2005 to 2009, 11% took business courses that included entrepreneurship and marketing (Kiernan and Ledwith 2014: 227). Thirty-one per cent chose to stay in design by broadening their skills in graphics and digital media, according to the data generated by Kiernan and Ledwith (2014).

A conclusion of the above might include business and marketing strategy be included in designers' training in order to cope with the changing marketplace. Inasmuch as the research was published in June 2014, the authors did uncover a basic need albeit in Ireland regarding design, designers, and design education. They did review opportunities for designers, which by itself recognises the value of a degree, albeit, the assessment of the limits of the degree is not noted beyond the needs in Ireland—the premise being that if those schooled in Ireland could have training in managerial skills, the opportunity for graduates' employment within the country might be more secure.

Based on some of the above writings referencing issues beyond technical skill training for practice, advanced training in a complete business suite of coursework should be considered and undertaken. The initial reason given by the authors for the unemployment of industrial designers within the country is that Ireland and many other 'Western' manufacturers are no longer producing goods in-house. The implications for practice include the need for more graduate education that combines the base interest of the designers. This would/could include data analytics, graphics and digital media, as well as extending coursework to include business-based classes.

2.5.6 Entrepreneurship within design based programme

Entrepreneurship as a discrete course within an overall design and/or development management programme is addressed in 14 of the 35 programmes that meet the criteria established for this thesis. A review follows as it relates to graduate programmes.

In conjunction with the United States Association for Small Business and Entrepreneurship, the question, 'How can current design and development management pedagogy respond better in reflecting industry needs?', may have been written by Solomon and Matthews (2014). Entrepreneurs are described, as are the typologies of entrepreneurs dealing with introducing new goods or services, motivations, and the nature of risk. Mention is made of Schumpeter's work (1911) where Schumpeter clarifies 'that a distinction can be made between the pursuit of steady state and accelerate growth-oriented entrepreneurs and ventures'. While this clarification is

dedicated to entrepreneurs, it can and often does relate to those who practice product design and development management.

The growth of interest in educating those in entrepreneurial studies is recognised by Solomon and Matthews (2014: 100). Data from the 'National Surveys of Entrepreneurial Education', a survey conducted from 1979 to 2003 refers to combined entrepreneurship and small business management courses that have grown from 93 to over 1600. The study (Solomon and Matthews 2014: 101) indicates that basic management courses are remaining constant while 'various courses more suitable to scalable ventures are proliferating'. The diversity of students and their individual needs based on entrepreneurial interests—as described by Blenker et al., (2006)—recognised a variety of different approaches and coursework amongst universities. The writings also recognise that traditional business programmes are no longer absolutely relevant to the needs of today's changing business environment. The comment might have great relevance in the teaching of product-design- and development-management-type courses.

Twenty-one topics found in the basic literature of these small business/entrepreneurial programmes were reviewed by Solomon and Matthews (2014) and ascertained that none or all are correct subject-matter unto themselves, but rather the degree of emphasis placed on them in the classroom does and should vary. The summary by Solomon and

Matthews is that further investigation of the syllabi and textbooks is needed.

Figure 13: Course subjects for steady state/small business and accelerated scalable growth topics and emphasis, comparing 30 institutions, Solomon and Matthews (2014: 107)

A conclusion is reached by Solomon and Mathews (2014: 109): 'From a pedagogical perspective, educators should focus on more experiential activities while integrating case analysis development of real life cases and student based consulting projects'. When the above coursework in figure 13 is compared to the specific coursework identified by the 35 institutions offering advanced degrees in product design and

development management, the overlap is in all courses with the exception of the following:

- Government Regulations
- Buying Existing Businesses
- Family Business Succession
- Home-Based Business
- Taxes and Insurance
- Business Failure/Discontinuance
- Bank Relationships
- High Growth
- Exit Strategies

However, it should be noted that within the programmes teaching entrepreneurship, those subjects may be included. What does stand out is the overlap of the following classes that would include 29 institutions teaching 'Business Fundamentals' (or 'Internal Management') and a minimum of 8 institutions teaching 'Equity Financing' ('Capital Markets') with degrees in product design and development management.

Marketing
Opportunity (various names)
Internal Management (various names)
Human Resource Management
Accounting
Finance
Technology (under various names)
Innovation / Creativity
Behavioural Traits/ Motivations
(Organizational Behaviour)
Equity Financing

Of the 35 identified institutions with coursework culminating in a degree in product design and development management, 31 have an 'integration' project and include 'business plans', which the authors suggest should be included in the focus for the pedagogical and curricular needs. The authors recognise changes and individuals' needs within the teaching of business and entrepreneurism. The variables are so great, starting with the basic two types of entrepreneur, that a fixed curriculum for all might not benefit any.

The premise is that entrepreneurs fall into 'steady state growth oriented' modes or 'accelerated growth' oriented modes (Solomon and Mathews 2014). Since the steady state manage existing or new businesses, they concentrate more on lifestyle or salary replacement for support rather than the accelerated growth focus, who create new and innovative products processes, services, or new ventures for-profit or not-for-profit.
At issue may be the need for individual teachings for both areas as well as an overlap for individual personas. The overlap is equally important to both groups and recognises issues that include opportunity recognition, start-up actions, internal management issues, human resource management issues, taxes, insurance, accounting, finance, technology, business failure and discontinuance, bank relationships, and innovation/creativity.

2.5.7 Rethinking graduate education

There is an important role for design thinking in project-based learning; there is also a recognition of collaboration for emerging leaders, as was noted by Hardin et al., (2014). In reviewing the institutional approach, the writers came to the conclusion that three types of institutions and course work were developing for graduate education:

1. Creative networks, non-profits, well-funded entrepreneurs, and bootstrap start-ups, with online innovation.
2. Partnerships between design-based schools and business/engineering based schools and/or programmes, to include partnerships such as the Rhode Island School of Design (RISD) and Massachusetts Institute of Technology (MIT) [3]
3. Dedicated programmes that integrate design, engineering, and commerce into a single programme and reference—as an example, Philadelphia University's programme headed by the three deans from the above colleges within the university.

Figure 14 is a graphic delineating the continuum of education institutions and consisting of 4 main frameworks, developed by Junginger (2009) and noted by Hardin *et al*., (2014). It includes 'Design as External Resource'; 'Design as Part of the Organisation'; 'Design at the Core of the Organisation'; and 'Design Integral to all Aspects of the Organisation'. In referencing 'Design as External Resource' Hardin et al., (2014) believe those are limited to executive education including the Stanford 'D' school.

[3] While the above example refers to the RISD and MIT partnership according to the 'Advanced Degree Programs Offered' (http://www.risd.edu/academics/graduate-studies/degree-programs/), there does not exist such a joint programme.

Figure 14: Design in the Organisation: Parts and Wholes (Junginger 2009)

When referring to 'Design as Part of the Organisation', Junginger (2009) subdivides that broad category into 'Design Thinking Class' programmes and 'Design Learning Project Catalyst'. When referencing 'Design at the Core of the Organisation', Junginger references 'Design Department as Integration Catalyst'. For 'Design Integral to All Aspects of the Organisation', Junginer notes 'Integrated Departments'. For those involved in industry as well as educators, there is the holistic thought that empathy

> "is a leading core competency that drives design thinking...[Industry further believes that] graduate education should include a formal analysis and understanding of design-thinking principles, practices, and tools sets, complemented with studies of leadership, organization behavior, psychology, anthropology, and other social sciences to help develop a rich and diverse understanding of human cultures and psyches". (Junginger 2009: 16)

According to Hardin et al., (2014: 17), designers alone 'have a gift for empathy, visualisation and craft-based skills'. They contend that designers are best qualified to recognise alternate solutions and are therefore valuable across the broad spectrum of

business. However, they also recognise the teaching opportunity, which explains the new MBA interest in integrating design and design thinking.

Figure 15: Word cloud regarding clarification of core competency needs, Hardin 2014

The word cloud in Figure 15 was based on Hardin *et al*., (2014) approximately 150 interviews with practitioners, educators, and students by the authors. It was created in an attempt to clarify those core competencies as being most important for design thinkers in business. The authors appear to conclude that two characteristics are primary for design thinkers, each of which are equally important: (1) reframing the problem and (2) understanding empathy. When the above image was presented at the 2014, DMMI Chicago workshop of designers, students and representatives from industry, a different picture emerged in terms of leadership characteristics. Those keywords included leadership, self-awareness, collaboration, entrepreneurial/innovative attitude, communications, facilitation, visualisation, teaching, storytelling, maker mentality, and culture making (Hardin et al., 2014: 18).

Ultimately, the authors developed and published for DMI a business curriculum (see Figure 16).

Figure 16: Business curriculum as developed by Junginger 2009

The business curriculum discussion includes comments from Tom Berno, a professor of communication design at Texas State University, who commented: 'Today, most graduate education institutions lack agility, and many faculty are surprisingly insulated from—even actively indifferent to—the pace of change in our industry and its growing relevance outside the realm of its traditional boundaries. It is clear that design thinking is still in its early phase of influence' (Hardin et al., 2014: 19).

Design thinking needs to be integrated into graduate programmes both at the MBA level as well as those in design management, according to Hardin et al., (2014). Their preliminary research, based on 150 participants, suggests the most important traits for design thinking include the reframing of the problem and the understanding of empathy.

However, the gathering of professionals and educators recognised the values of leadership, self-awareness, collaboration, entrepreneurial/innovative attitude, communication, facilitation, visualisation, teaching, storytelling, maker mentality, and culture making.

The solution might suggest that the principles of design thinking need to be primary in graduate programme . Faculty need to be more involved and go beyond technical skills training. Soft skills, starting with leadership, that include empathy and collaboration are most important.

Implications for practice should be self-evident in teaching in the area of design and development management. Those concentrating on graduate education within design disciplines need to appreciate and accommodate the growing business need that puts leadership with empathy at the core of design thinking. 'Is Empathy the Missing link in Teaching Business Ethics?' is a thesis by Adkins (2009) which addresses this issue by suggesting it is the missing link.

2.5.8 Design as part of design management

If design is at the centre of the corporate agenda, why is there not more consistency in the coursework being taught at the master's level of managerial programmes dealing with design/development/innovation? Professor Rachel Cooper, writing the forward for Vision and Values in Design Management (Hands 2009: 11) attempts to answer this and notes that the UK Design Council 'launched a host of initiatives aiming to bridge the divide between design and business: knowledge providers such as higher education

institutions and the commercial sector placed design at the centre of the corporate agenda'. Her comment is at the heart of this thesis exploration.

Cooper notes that the champions of design are differentiating through not only product design but also through the creation of environmental experiences. So again, the question arises that while all design-centric managerial programmes deal with the base subject of design, are they also dealing with environmental experiences? The word 'environmental' is meant to describe the totality of the design experience.

Since this thesis research is based on USA institutions in terms of specific coursework, reference is made to 'the US and Japan have progressed by integrating design on a strategic level rather than employing it solely as a tool to enhance the aesthetic appearance of existing products or surface decoration' (Hands 2009: 14). In 'The Value of Design' chapter, it is noted that design could contribute by reducing production costs while increasing customer loyalty with an understanding of benefits. It continues that in highly competitive markets, concurrent with reducing customer complaints, better design of information makes for better products. The thought concludes by making reference to that idea: 'by utilizing the customer experiences business aligns with the brand' (Hands 2009: 14). The research identifies that 'brand' should be an issue in design education for those managing the subject. The paper also brings light to the National Health Service (NHS) attempting to ensure that the service components are more important than the product offering.

2.6 Preferred Skills as Recognised by Recruiters

The subject of preferred skills was asked of 1,320 corporate recruiters as reported by Otani (2015). The goal was to name the skills most valued and was specifically asked of those who recruit MBAs. That master's programmes in the management of product design and development generally include MBA-type coursework, the preferred skills believed to be of importance to recruiters of MBAs is of keen importance. The report is delineated by industry sectors and noted the following:

1. Financial Services, banking, accounting
   - Communication skills
   - Analytical thinking
   - Motivation/drive

2. Consulting
   - Communication skills
   - Analytical thinking
   - Creative problem-solving

3. Technology
   - Communication skills
   - Ability to work collaboratively
   - Analytical thinking consumer products

4. Healthcare, medical
   - Communication skills
   - Leadership skills
   - Ability to work collaboratively

5. Manufacturing
   - Strategic thinking
   - Communication skills
   - Ability to work collaboratively

6. Pharmaceuticals, biotech
   - Strategic thinking
   - Communication skills
   - Ability to work collaboratively

7. Retail
    - Communication skills
    - Analytical thinking
    - Strategic thinking

8. Transportation
    - Analytical thinking
    - Strategic thinking
    - Communication skills

9. Chemicals
    - Communication skills
    - Leadership skills
    - Analytical thinking

10. Energy
    - Analytical thinking
    - Communication skills
    - Leadership skills

Note that 'communication skills' is amongst the top 3 skills requested by recruiters. This should be of relevance in designing a master's program in product design and development management. The listing of 'importance' is in order with The percentage of recruiters who believed is as follows:

1. Communication skills 68%
2. Analytical thinking 60%
3. Ability to work collaboratively 55%
4. Strategic thinking 53%
5. Leadership skills 50%
6. Creative problem-solving 42%
7. Motivation/drive 38%
8. Adaptability 29%
9. Quantitative skills 26%
10. Decision-making 20%

As noted, the highest-rated course in importance, as brought forth from MBA recruiters, is communications. The importance is that 'Communications' was also voted one of the 12 top subjects by 20 corporate leaders, 90 alumni of one programme in this subject area, and educators who concentrate on this area of study. For the 90 alumni, who were responding to a query of 48 potential courses, the one course garnering the most '9' and '10' votes out of '10' was 'Communications', with 71 alumni out of 90 voting. When those who rated 'Communications' either an '8', '9', or '10' were included, the count rose to 83 of 90 respondents.

'Analytical Thinking', or the ability to gather information, articulate, visualize and solve complex problems (Manning, 2014:1) was second highest in importance by recruiters of MBAs. However, the subject as a stand-alone is not even taught in any of the 35 worldwide institutions concentrating in master's degrees dealing with product design and development type management degrees.

2.7 The Question of Rigour Versus Relevant Gap

The answer to the question of 'why the gap?' may be as simplistic as 'follow the money'. If one 'follows the money', one can find funding for many areas of study, some of which is directly beneficial to practice and some which may be of interest to academics, but as noted elsewhere may be of little to no value for practitioners. The money availability, coupled with a publish-or-perish mentality, might explain the rigour versus relevance gap. Markides, (2007: 783) notes; "the underlying structure of the academic system does not encourage managerially relevant research".

In 1984, it was recognised by Shrivastava and Mitroff that the gap was occurring within the field of organisation research. Organizational research is noted as this is one of the subjects that could be (and is often) taught within the product design and development management curriculum. There was the false idea that researchers in that field were developing knowledge that was considered important by decision-makers, according to Shrivastava and Mitroff (1984). They argued that 'a major reason for the lack of use of scientifically developed organisation theories is that the assumptions on which those theories are based are quite different from the assumption that managers make about real world organizations' (2004:18). The authors made reference that scientific research relative to organisations is systematic inquiry, based on objective approaches with positivist methods and reference Burrell and Morgan (1979). It is noted that managerial decision-making within the practice field is not in itself formally structured. The reasons given are that in practice, there is theory coupled with bias and opinions, which are all influencers in decision-making but lack formal structure (Mintzberg 1973 and Pettigrew 1973).

References to engineering, marketing, information systems, and organisation behaviour, are made as all subjects that may be taught within the general category of product design and development management. The following funding data confirms that from a university research point-of-view, the majority of the funding goes to research and development within the sciences (BestColleges.com n.d.).

As illustrated in Figure 17, the largest amounts of funding go to both science and engineering, and 'other' being a distant third. The ratio of science and engineering

relative to ‘other’ is approximately 7:1. Noting this discrepancy, and more importantly, noting the amount, is that USA federal funding is approximately $142.2 billion; thus the ‘other’ is still considerable, as it is approximately $200 million dollars. Nevertheless, the chase for the money is considerably intense amongst the others, which include the MBA-based coursework.

The money, however, must be awarded, and thus the amount of publications, hoping for funding, is considerable

Figure 17: Federal funding trends in the USA, as developed by the American Association for the Advancement of Science (AAAS) .

Irrespective of the above, Rynes *et al.,* (1999) noted mixed results regarding the issue of whether researchers who spent more or less time doing organisational research achieved greater learning. In the reference to Rynes *et al*, it was found that in formulating

research questions, practitioner involvement proved to be negative. It should also be noted that in their work, efforts were directed only toward top-tier journals.

In the search for evidence regarding cooperation between academics in organisational behaviour and professionals, Rynes *et al*., (1999) reviewed submissions to the *Academy of Marketing Journal* (*AMJ*). Of 49 submissions, 40 were rejected without, or upon, first review. Ultimately, only five were accepted, and the reason stated for that number was that those not accepted had no data. One might conclude that academics have a tendency to apply for journal acceptance without data, as the need to publish is so great.

Inasmuch as 'management' is a key component of coursework for this study, attention needs to be paid to the teaching of management courses and the gaps between the academics and those who practice: 'Academics are more likely to see knowledge as stable, based on established academic premise legitimised from Academy. Practitioners are more likely to see knowledge as emerging from action, as dynamic and legitimised by results' (Ash 2014: i).

The alarming gap as described by Reibstein *et al.,* (2009), makes reference to the growing gap between academia and the needs of marketing reviews within the fast changing marketplace. The authors continue to bring up the already familiar rigour versus relevance argument and discuss how this divergence is detrimental to the field. Reibstein *et al*., question why marketing academics have little to say about emerging issues and technologies. They express concern regarding a lack of voice about so many issues, including open innovation, blurring of value chains, and unethical practice; and

with respect to academia and their research, the authors admit the audience resides within the marketing research departments. Especially noted are there comments regarding the MBA focus on narrow analytical and cognitive skills and the treatment of complex issues, all taught by those with no business experience. Reibstein *et al*., (2009: 2) summarise by noting, 'there is an alarming and growing gap between the interests, standards and priorities of academic marketers and the needs of marketing executives'.

Of considerable concern are the numerous writings and the minimal, if any, knowledge imparted by academia on the professions. Whilst the most widely cited journals include the *Journal of Marketing Research*, *Journal of Marketing*, *Journal of Consumer Research*, and *Marketing Science* (Guidry *et al.,*), a 20 person sampling of professionals indicates none in that group subscribes to or references these journals.

The subject of knowledge management and a firm's competitive strategy coupled with an insufficient analysis of this experience-based tacit knowledge, which is 'beyond the reach of language' (Johannessen 2006: 229) is referred to in Worrall's (2008) musings. Worrall notes that business sees little value in ever consulting academia with respect to business subjects and goes on to state that while the UK Government policy has been focused on knowledge transfer from universities to businesses, the actual transfer of 'management knowledge is not taking place' (Worrall 2008: 2). He further notes that management research has had little effect on actual practice.

Whilst theory drives scientific research, one might expect, that academic theory drive professional activities in business and especially in marketing. In spite of the plethora of

publications, the writings by McCole (2004: 531) reflect that 'it is difficult to recall a single 'theory' that has been developed by marketing academia for marketers'. According to McCole, there is a considerable amount of writing reflecting on the subject that marketing itself is dead; although he himself does not believe that to be true, he does reflect on the fact that marketing is changing, and the gap between academia and practice is severe. He recognises the need for a new set of theories for marketing, developed by marketers themselves, as he reflects that marketing is going through a mid-life crisis.

He refers to what he calls the birth of modern marketing with Drucker (1954), who stated the following:

> Marketing is the unique function of business …it is the whole business seen from the customer's point of view. Concern and responsibility for marketing must permeate all areas of the enterprise. (Drucker 1954: 36)

A continual cross-disciplinary input from business must be present for the vitality of the field, according to McCole (2004), who notes that we should not be forgetting about all that has been done in the field but calls for greater discourse in the re-examination of the field, not the re-invention. He summarises that traditional teachings need revision, not abandonment, and that what is reflected in the teachings is not representative of best marketing practices.

The impression that academics are spectators and have little concern for relevance has been thoroughly examined by Ash (2014) with 20 additional references and even a reference to Dewey (1938). According to Ash (2014: 3),

> Assundani (2005) outlines two differing epistemic frameworks that obtain in academy and practice. These are modernist epistemologies of possession where

> knowledge is owned by individuals and associated with the Academy. Alternatively, epistemologies of action or process are more postmodernist and likely to see knowledge as dynamic, emergent and contextual and are more likely to be rooted in outcome, tacit in nature and potentially more practice oriented.

There is recognition that the divide of the teaching versus practice gap, and the question of that being real or myth, are being resolved as 'real', as written by Bruce and Schoenfeld (2006). In their writing, there was no one individual coming forth or writing a paper to defend it as being a myth. According to them, the gap is real and has not been challenged by academia.

These areas of gap are important in attempting to understand coursework for a master's degree in product design and development management. And the concern is rather basic, in that Marketing, Business, and Marketing Research are courses that many professionals in the field believe to be critical for one to manage in the field.

Of concern to all, is that the theory-practice gap in management, in general, has been with us for a long time. Bartunek (2007) is reported to have recognised the start date of formal discussion from at least 1958, almost 60 years ago. He also recognised that multiple answers to the issue have been offered during that time, as there have been at least three Academy of Marketing conferences devoted to the subject in the past 15 years (Academy of Marketing 2014). The Academy of Marketing even has a LinkedIn group set up on 'Bridging the Marketing Academic/Practitioner gap', chaired by Steve Baron of the University of Liverpool.

Of considerable interest is that the Association of Business Schools (ABS), as reported in Ash (2014: 16), had similar concerns for courses taught in business schools, as they

'lack relevance, topicality and application focus'. They (ABS) continue to suggest that rather than addressing the needs of business, the current business courses taught reflect the interests of the academics. Other organisations have studied the subject, including the Association to Advance Collegiate Schools of Business (AACSB), and confirmed that management executives virtually ignored business school research, according to a study commissioned by AACSB and performed by Dossabhoy and Berger (2002). The authors make reference to Dean H.J. Zoffer of the Katz School of Business at Pittsburgh University, who stated the following: 'We need to create a more real world environment…either you've got a practitioner who knows nothing about scholarship or an egghead who knows nothing about practice. These worlds have got to begin merging' (Dossabhoy and Berger 2002: B2).

They continue and reference a report, 'Leadership for a Changing World: The Future Role of Graduate Management Education' (Stahl *et al.,* 1988), which found business schools 'overvalue academic rigor and undervalue relevance of the practice of management'. In an effort toward bridging the gap, Dossabhoy and Berger (2002) developed a model of major criteria for strengthening research (see Figure 18). The guide included the criteria of criticality, verifiability, validity, utility and clarity. They divided their graphic into the 2 halves representing the academic world and the 'executive' world.

The academic half includes validity and verifiability whilst the executive half includes criticality and utility. The blend of the two resulting in clarity.

Figure 18: Model for strengthening research by bridging the gap between academic world and the executive world (Dossabhoy and Berger 2002)

Whilst the subject has been reviewed by the researcher and whilst AACSB offers accreditation for MBA programmes, they do not have required coursework for that accreditation. The question for the issue of 'gap' is one of appreciating it as part of MBA programmes. Dacko (2006) questions whether marketing students are given the 'right opportunities to acquire the right knowledge and learn the right skills'. The concern is one of inadequate preparation, which may result in career inadequacies. Dacko (2006) references Baker and Holt (2004) in that in the area of marketing, academics and practitioners have to bridge the on going divide: 'Skills in how to write more effectively, how to orally communicate, how to manage time better, how to lead, and how to be a better risk-taker are just a few examples of key and essential skills for marketers' (Dacko 2006). However, it is also recognised there is a lack of consensus as to what skills are most critical as well as the level of skills that must be learned by MBAs. A referral is made to the work of Brennan and Ankers (2004: 517), in that

practitioners would rather work with consultants than academics, as they believe that will allow for more useful knowledge.

Bennis and O'Toole (2005) recognised deficiencies that mitigated the gap. Those deficiencies included;

Failure to impart useful skills

Failing to prepare leaders

Less than relevant curriculum

Focus on narrow research interests at the expense of practice

In their own writings in the *Harvard Business Review* (2005) entitled 'How Business Schools Lost Their Way', the subheading notes the following:

> Too focused on 'scientific research', business schools are hiring professors with limited real world experience and graduating students who are ill-equipped to wrangle with complex unquantifiable issues—in other words, the stuff of management. (Bennis and O'Toole 2005)

Whilst the ultimate goal is to advance the coursework in the USA by having those institutions that include master's degrees in product design and development management, a reference to a UK review is deemed important. In an effort to advance ways to enhance management research, in a world-class manner, and specifically to assure the UK economy would gain in competitiveness, the Advance Institute of Management Research (AIM) embarked on a mission to appreciate the direction of business schools in the UK. The work was published as 'The Future of Business Schools in the UK—Finding a Path to Success' (Ivory *et al.,* 2006). Amongst their reports, the following was included regarding conflicting themes in the debate regarding business schools and relevance (see Figure 19).

Figure 19: Conflicting Themes in the Debate on Business Schools (Ivory *et al.*, 2006: 8)

In support of this AIM report, as also referred to by Ash (2014), who references Thomas (1997) and Wilson (2002), the latter two authors claimed the obviousness of a theory-practice gap and called for the teaching community to recognise and engage the needs of practitioners and to leave their ivory tower. These views were further confirmed with Thompson (2004), Riebenstien *et al.* (2009), and Baker and Holt (2004), who went beyond the above and suggested academic marketers were too involved in overly abstract research and as a result were losing the influence of professional practice.

Ash (2014) commented that due to early criticisms of business schools being no better than trade schools in putting forth anecdotal stories (Bennis and O'Toole 2005), the

concerns regarding lack of rigour culminated in the recognition of poor business programme . That recognition of lack of rigour started as early as the 1960s. To counter this recognition, as well as scholarship in the philosophy of science and the use of theories, a trend began amongst USA marketing authors. This new breed of marketing authors believed their work to be scholarly, as supported by references to Crozier (2004) and Cunningam (1999). Most recently, as noted by Ash (2014), the editor of the *Journal of Advertising* stated, 'I do believe of course, the theory-based papers should have something to say about practice...but it is my belief that the best way to make contributions to advertising practice is by building a solid theory of practice' (Zinkham 2003).

One of the issues noted by Ash (2014) was that managers did not appreciate, and were not sensitive to, scholarly language. As such, there was no ability to reference the journals or the academics for solutions that were not understandable.

2.8 Summary

This chapter has reviewed evidence of the issue of divide between academia and practitioners. The researcher has reviewed both the institution and the practitioner issues contributing to the divide. The AACSB (Association for the Advancement of Collegiate Schools of Business) has suggested business schools need to demonstrate the value of the research they bring to the everyday world, supporting the argument of rigour versus relevance. And, whilst there are writings for managerial coursework, albeit not necessarily based on need, there is a lack of commonality of coursework for product

design and development management. Pedagogical views have been put forth as have preferred skills from recruiters, who place as number one, communication skills.

In the following chapters, the research methods and the filters used to gather information deemed critical for those in industry leadership desirous of hiring managers for product design and development and will put forth the results of that work.

Chapter 3: Theoretical Perspective / Research Methods and Methodology

3.1 Introduction to the Review

The chapter introduces a perspective and research methods; an overview of the background of programmes offering a master's degree in product design and development management to allow for an appreciation of the methods chosen; a discussion of and definition of 'leadership' as it pertains to the study; and the backgrounds of those participants representing design centric leadership. It further references an overview of the 35 programmes involved in product design and development management and the naming of them. Research methods chosen are clarified, as is an understanding of a design-centric organisation's ethos. The chapter includes a clarifying section regarding accreditation agencies as they relate to business-based master's degrees, the general coursework one receives within business degree programmes , and the relationship to product design and development management programme .

3.1.1 Introduction and overview

The methods employed for the research include a reliance on Archer (1995: 6) in reflecting multiple ways of defining research and ways it can be carried out. Referencing 'research in general'. Archer notes, 'Research is a systematic inquiry whose goal is communicable knowledge:

- Systematic because it is pursued according to some plan
- An inquiry because it seeks to find answers to questions

- Goal directed because the objects of the enquiry are posed by the task description
- Communicable because the findings must be intelligible to have located within some framework of understanding for an appropriate audience' (p.6).

Archer continues his descriptions and notes 'there are several distinct categories of research" (ibid:6) and notes the following categories.

Fundamental; for enquiry directed toward new knowledge without any useful application for present usage.

Strategic; for the filling of gaps in the above 'fundamental' or to narrow gaps with useful information

Applied; for systematic enquiry for purposes of acquisition and conversion into particular applications

Action; for the investigation and practical activities for testing of new information to produce knowledge

Option; for the systematic enquiry towards acquisition to allow for decision making or action.

Based on Archer's overview this research falls under the general category of 'strategic research' as it has 'useful applications' in understanding the current state of master's degree education in product design and development management and will narrow and/or fill the gap between fundamental, which is without any useful application and new knowledge, but with useful applications. The researcher for this subject is of the opinion the work provides useful application as there is little commonality regarding courses taught in the 35 programs reviewed.

Archer discusses the basic 'ground rules' of the scientific approach to research, based on rules set forth by Bacon whereas the process is empirical, based on evidence, and is objective and free from judgements from the researcher, but inductive which moves from observation to the formulation of general 'laws'. Archer continues by also referencing the work of Popper whereas 'falsification of theory, not verification , should be the aim of scientific enquiry.'(ibid:7) Based on that reference Bacon summarises the modern approach to research which requires the researcher to be liberal about the basic hypotheses; to be sceptical during research; and to be astringent regarding explanations upon completion. The researcher for this work, believes the work meets those requirements.

In attempting to follow Archer's systematic inquiry, the plan is one of investigating institutions for an understanding of what they teach as subject matter and what the leaders of those institutions believe should be taught, followed by understanding what industry leaders believe to be most relevant in terms of core competency. It is goal-directed, as outlined in Chapter 1, Aims and Goals. The presentation of the information is communicable, as it answers five discrete goals with objectives in a clear, easy-to-comprehend manner in Chapter 6.

One could construe this research as 'action' research as it is 'systematic…through practical action calculated to devise…new information…and to product communicable knowledge" (ibid: 6) This method would also resolve the coursework appropriateness, (Pernecky 1963: 33), as it would be quantified in the opinions of leaders of industry. As further noted by Pernecky, this work could be construed as action research as it is not

particularly interested in the abstract but rather in studying the existing problem and with particular people, the emphasis of which falls into two areas—one being the solving of the problem and the second being a learning experience for the researcher. For purposes of this document, the research will be defined as ‘strategic’ for the above reasons noted.

Upon review of all programme coursework, an analysis will be made by reviewing a questionnaire responded to by industry leaders based on their expectations of course work for a manager of product design and development. The questionnaire will allow for ranking of each of the 68 subjects taught to determine if there is a defining set of core classes that all institutions rely on for their teachings. The study will include listings of core subjects taught in those institutions, interviews with USA academic programme leadership and industry leadership for a study of their needs, as well as a survey of alumni from a leading USA programme at Northwestern University . A detailed review is addressed in 3.10, Designing The Questionnaire.

The conclusion will be programme curriculum recommendations that are USA-centric in an effort to codify teachings based on industry needs. In beginning this review, the following mind map (see Figure 20) will serve as a guide. The mind map centres on the query and explores the possibility of leadership interviews from within various USA-based corporations; interviews with leadership of the USA-based institutions with master’s programme in this field; the various journals, books, and writings on the subject; conference write-ups; and any potential theses.

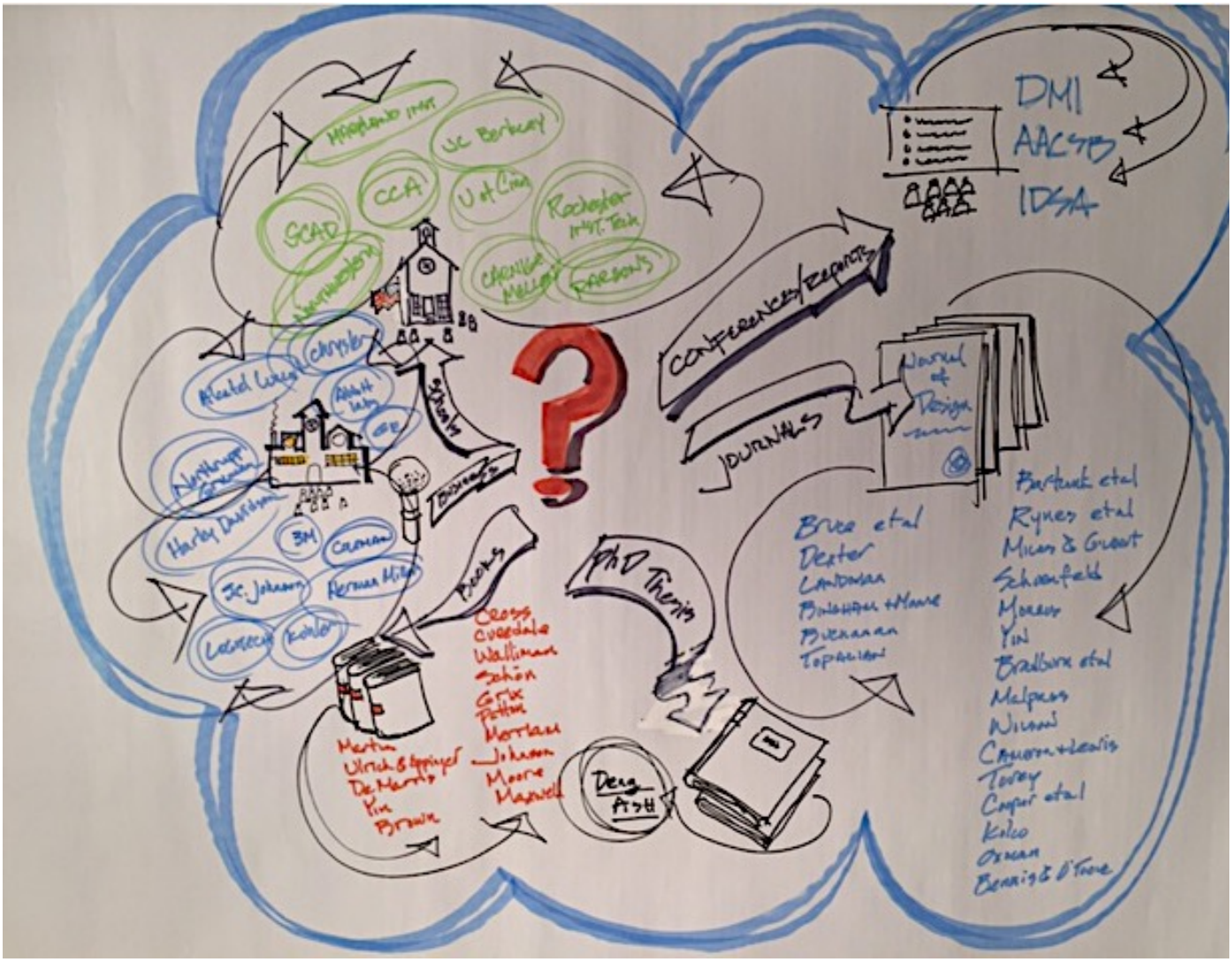


Figure 20: Mind Map, sketched on white board, of research subjects

3.1.2 Background

In comparing coursework from all other known programme that followed the initiation of the Northwestern University programme, there is a minimal amount of common core coursework taught, and there is a lack of common naming for these programmes . With no commonality of coursework, the problem becomes one of understanding for the audience of professional leaders who hire management for product design and development.

The aim is to determine if there is a common the state of the art with-in leadership relative to their professional needs when hiring individuals with a capability for the management of design and development.

> The kinds of knowledge honored in academia and the kinds of competence valued in professional practice has emerged for me not only as an intellectual puzzle but as the object of a personal quest... There are institutions committed for the most part to a particular epistemology... that fosters selective inattention to practical competence and professional artistry... we are in need of inquiry into the epistemology of practice. (Schön 1983:vii)

With an understanding of what is valued in this subject matter for professional practice, Schön recognised the absence of responding to professional practice by academia, and the need to better understand the epistemology of practice as the aim.

3.1.3 Issues and concerns

Due to the lack of shared commonality amongst coursework, the question being asked is, ‘what is the issue, and what is the concern?’ And ‘what might be the core curriculum based on industry leader opinions?’ Whilst there is not now a common core, should there be? What is the rationale behind the current diversity of courses being taught? Of equal concern is the question of ‘audience’. Is the audience the graduate students studying for the degree or those in industry hiring those with this particular schooled knowledge? The course work from the academy for producing professionals for the field, as well as the professionals needs that are doing the hiring, are investigated and discussed using questionnaires as referenced in 3.10.

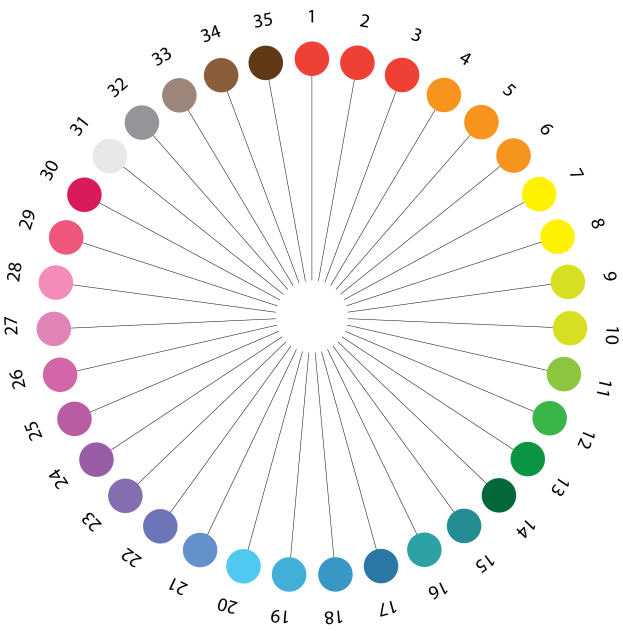
3.1.4 Institutional overview of degree variance

The universities offering these master's programme have a blend of coursework that normally includes engineering, design, and management (Appendix A). The management coursework generally emanates from the academy's business colleges. These design and development management degrees are awarded from a variety of colleges, including engineering-based as well as business colleges and art-and-design schools. The degrees awarded also show a variety of names:

- MSc Product Development
  - Chalmers University of Technology
  - Rochester Institute of Technology
  - University of Detroit Mercy
- MSc Integrated Product Design
  - Brunel University of London
  - KTH Royal Institute of Technology
  - University of Pennsylvania
- MSc in Product Design & Development Management
  - Northwestern University
  - University of Warwick
- MA / Master in / MFA / MPS (Master of Professional Studies) Design Management
  - Lancaster University
  - IED Barcelona (Spain)
  - SCAD The University for Creative Careers
  - Pratt Institute
- MSc Product Design
  - Bournmouth University
- MSc Product Design Innovation
  - Aston University
- MBA in Design Strategy
  - California College of the Arts
- MSc of Integrated Innovation for Prod & Services
  - Carnegie Mellon University
- MSc Design in Design, Strategy, Leadership
  - Cranfield University
- MSc Product Innovation
  - Virginia Commonwealth University
- MSc Design Management
  - IED Barcelona
- MDesign/MBA
  - Institute of Design, Illinois Institute of Technology
- MSc Strategic Product Design
  - International Hellenic University
- MBA Certificate in Design & Innovation Management

    - Kendall Art and Design College
- MSc International Innovation (Design)
    - Lancaster University
- MBA/MA Design Leadership
    - Maryland Institute College of Art
- MSc Integrated Design & Management
    - MIT
- MSc Strategic Design & Management
    - Parson's New School of Design
- MBA Strategic Design
    - Philadelphia University
- MPS (Master Professional Studies) in Design Management
    - Pratt Institute
- MA in Industrial Arts
    - San Francisco State University
- MFA Design Management
    - Savannah School of Art and Design
- MBA/MFA
    - Schulich School of Business (York University)
- MSc Innovation Management
    - Tu/E Technische Universiteit Eindhoven
- MSc Innovation & Product Design
    - University of Applied Sciences Upper Austria
- MSc Product Design Engineering
    - University of Glasgow
- MSc (Engineering) Prod Design & Management
    - University of Liverpool
- Design Management Master of Arts
    - Birmingham City University
- MAdvanced Design Management, Strategy and Entrepreneurship
    - ELSIVA Barcelona School of Design and Engineering and Pompeu Fabra University (UPF)

The following figure 21, is a graphic representation of the above list with the common colours referencing the same names of the programmes.



1. Chalmers U of Tech MSc P Dev
2. Rochester Inst Tech MSc P Dev
3. University Detroit Mercy MSc P Dev
4. Brunel Univ. London MSc Integ PDsgn
5. KTH Royal Inst or Tech. MSc Intrg PDsgn
6. U Penn MSc Intel P Dsgn
7. Bournmouth University MSc P Dsgn
8. Cardiff School of Art & Design MSc P Dsgn
9. Northwestern University MSc PDDM
10. University of Warwick MSc PDDM
11. Aston Universtiy MSc PDsgn Innov
12. Calif. College of the Arts MBS Dsgn Strat
13. Carnegie Mellon M of Integ Innov for Prod & Serv.
14. Cranfield Univ. M of Dsgn in Dsgn, Strat & Ldrshp
15. Virginia Commonwealth M of Prod Innovation
16. IED Barcelona M Dsgn Mgmnt
17. Inst of Design IIT (Ill Inst Tech) M Dsgn MBA
18. Intl Hellenic Univ. MSc Strat Prod Dsgn
19. Kendall Art & Dsgn MBA Cert in Dsgn & Inn Mgmnt
20. Lancaster Univ MSc International Innov (Dsgn)
21. Maryland Inst College of Art MBA / MA Dsgn Ldrshp
22. Milwaukee School of Eng. MSOE
23. MIT MSc Integrated Design & Managment
24. Parson's New School Dsgn MSc Strt Dsgn & Mgmnt
25. Philadelphia Univ. MBA Strategic Dsgn
26. Pratt Intl MPS (M rof Studies) in Dsgn Mgmnt
27. San Francisco State Univ MA in Indust. Arts
28. SCAD (Savanah Schl Art Dsgn) MFA Dsgn Mgmnt
29. Schulich Schl of Bus (York Univ) MBA/MFA
30. Tu/e Technische Universiteit Eindhoven MSc Innov Mngmt
31. U of Applied Sciences Upper Austria MSc Innov & Prod Dsgn
32. U of Glasgow MSc Prod Dsgn Eng
33. U of Liverpool MSc (Eng) Prod Dsgn & Mgmnt
34. Birmingham City Univ. Dsgn Mgmnt MA
35. Barcelona School Dsgn & Eng (ELISAVA)

Figure 21: Visualisation of Degree Names Amongst Universities

3.2 Ontology and Epistemology clarification of the Research Study

To assure clarity and based on Grix (2010) the starting point for this study is the ontology, whilst the epistemology is in knowing how we know about it. Blaikie (2000:8) takes it one step further and notes that ontological claims are:

"claims and assumption that are made without the nature of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other. In short ontological assumptions are concerned with what we believe constitutes social reality."

3.2.1 Ontology

The ontological assumption, based on Grix's (2010:8) brief descriptor of "what is out there to know about ", is that no educational standards for managerial training have been found by this researcher, for those involved in the education of product design and development management. The assumption is based on a review of master's programme teaching the general subject. The programme taught, act in an independent manner from each other and do not have a common core of subject matter.

The efforts of this study include an attempt to codify a curriculum in the hope that there might be a higher level of recognition for the degree and the understanding of the knowledge gained, in much the same manner as one appreciates the value of an MBA. A review of the coursework offered by leading institutions offering an MBA (*Financial Times* 2013) is also reviewed.

Additionally, a study of business thought leaders includes what they believe a successful graduate field of study and coursework should include. In addition to studying the thought leaders in industry, the academic leadership of these programme is also reviewed.

3.2.2 Epistemology

Epistemology is about the theory of knowledge, according to Grix (2010). Grix notes the ways of acquiring knowledge and the gathering of it are epistemology issues. It also refers to the strategy as to how the researcher will be gathering information on the basic

theory. It can be summarised as to how this researcher came to know this subject in depth.

The basic method of understanding will be purposive sampling using questionnaires and supported by one-on-one non-structured conversations if interviewees choose. Candidate selection of respondents will be based on the researcher choosing specific profiles that include leadership positions. In an effort to understand needs and/or wants from industry leaders, as well as trying to understand coursework deemed important by academia and recognising an absence of literature on the subject, a questionnaire with follow-up one-on-one opportunities for comments by respondents has been undertaken. Identical questionnaires sent to 90 respondents, all graduates of one product design and development management programme, have additionally been undertaken.

Applying a mixed combination of qualitative and quantitative research approaches (Creswell 2009) with current managers of product design and development management (Malpass 2012: 94) will enable a new curriculum to emerge. The questionnaire survey method was undertaken, as according to Fowler (2013), most people are familiar with market research designed to understand consumer preferences and interests; as such, survey research is aimed at primarily tapping subjective feelings. (Fowler 2014: 2). The basic methodological use of a questionnaire with respondents well versed in the subject matter will allow for two principal functions as described by Grix (2010: 32). The first offering a way of gathering information into a particular issue, and the second being one of enablement for another researcher's re-enactment.

The issues that need to be reviewed include the following:

1. What subjects are being taught?
2. What subjects need to be taught?
3. What filters should be used in reviewing USA programme ?
4. What data should be sought, using what methods, and from what subset to validate the research?

3.2.3 Issues driving epistemology

When one hires an individual to manage product design and/or development and/or innovation management, there is not only no common branding of the degree but an unknown as to what skills the individual brings. This is contrary to what takes place in the hiring of an MBA. Graduates with that degree have an education that includes very specific business and management skills that are recognised. Recognition of the degree and the high value of the degree are referred to in an article in which the 'MBA class of 2014... continued gains in technology and management consulting jobs...[and] ninety-four per cent of full-time MBA graduates seeking employment received a job offer 90 days after graduating' (Patterson 2014).

According to Business MBA (n.d.), MBA skills and competencies include adaptability, analytical skills leadership, problem-solving ability, teamwork, and time management. Additional competencies include finance, leadership, operations, entrepreneurship, strategy, globalisation, and technology (ITT).

The question becomes one of understanding if there is an epistemological gap between those in leadership positions responsible for the hiring of product design and development professionals, and those in academia delivering the education. The basic research goals include the following:

1. Developing a clear understanding through questionnaires amongst three distinct groups (educators, the design-centric leaders and the alumni from one programme). One on one 'interviews' will be held via phone, to capture the individual questionnaire rankings of 0–10. This technique is being used to further improve opportunity for response, instead of a paper survey form to be filled out and returned. The phone questionnaire will be recorded to further guarantee accuracy in the recording of the numerical response.
2. Clarifying the differences between academia and industry leadership for the development of a new curriculum

3.3 Research Methods

For the definition of methods, 'the techniques and procedures used to collect and analyse data are the tools with which we pursue knowledge… the methods employed… [and] are usually informed by the methodology chosen and the questions asked rather than the other way around' (Grix 2010).

3.3.1 Semi-structured interviews

The framework for this study included a cross-sectional survey developed to assess how senior professional and academic leaders value specific graduate courses of study. The

specific methods used included participants using a purposive sampling in a semi-structured, interview method (Miles and Gilbert 2005). The method was administered by telephone and recorded.

All respondents were supplied with an interview sheet prior to the initial interview (see Appendix F; G; H; I). The information expressed the subject matter to be reviewed, supported by an explanation of coursework and included a brief description of the course work. Respondents used the interview sheet during a telephone interview. Values asked for were on a scale of 0–10. The 0–10 value was explained to be a value of importance to their hiring of a director of product design and development—with the number '0' being of no value and '10' being of high value. All telephone conversations were recorded with a tape recorder whilst the interview was conducted by telephone using the 'speaker' mode. Any comments in addition to the numeric response, ranking each subject, was captured in the recording. Greater detail is provided in Chapter 5: Evidence-Based Specifications.

The data collected in the two leadership surveys referenced the work of Cummins and Gullone (2000). They make the claim that the 0–10 scale is the most intuitive and easiest to comprehend and conceptualise, and that naming points on a scale detracts from the interval. The authors espouse the naming of the points is quite unnecessary and actually detracts from the interval nature of the scale. Their solution is to adopt a ten-point end, defined scale, as it lies within common experience and allows greater sensitivity.

Data was collated to reflect the most important subjects for product design and leadership. ‘Most important’ was based on the values of 8-10 with the high and the low responses in each category deleted. The survey noted, ‘0’ was ‘strongly disagree’ regarding being essential as a core subject. Thus ‘5’ is neutral, 6-7 would be interpreted as having some important, and 8-10 was deemed most important for this researchers’ interpretation of values. All numbers were rounded to the closest whole numbers.

3.3.2 Online computer based survey

An additional online, computer based, survey questionnaire was developed referencing all coursework from institutions addressing masters’ students in the management of product design and development. The questionnaire was administered online to 90 professionals in the field, all of whom had graduated from the Northwestern University programme (see Appendix I). The intent was to appreciate the values they placed on the subjects they were exposed to in their own education as well as those subjects taught in other programme . The total number of course offerings for this survey was 48. Forty-eight were chosen, as those were the most taught of the 60 subjects uncovered.

3.3.3 Exploring institutional programmes

A review of core courses of those institutions awarding degrees in the management of product design and development has been completed. A spread sheet of those core courses from ‘MPDD’-type programme and an analysis of MBA core courses have also been completed. Understanding MBA core courses of study may help in the

identification of the basic subjects that the intuitions teaching these management programmes believe to be most appropriate.

3.3.4 Theory and case study

The basic hypothesis is that 'Professional leadership involved with product design and development will better recognise graduates from master's programmes in that field if their studies are consistent with needs as expressed by industry'. This proposition suggests a simple set of relationships, which is suggested by Yin, as one direction versus a more elaborate theory with more intricate patterns.

Yin (1981: 58–65) discusses the desired role of theory and the differentiator between pure case study and some qualitative methods, including ethnography (e.g. Van Maanen 1988). Yin (1981) notes that 'qualitative research may not necessarily focus on any case, may not be concerned with a unit of analysis, and may not engage in formal design work, much less encompass any theoretical perspective'. Yin recognises that good case study does use multiple sources of evidence. Yin notes there are common sources of case study evidence one can use in any combination, which include the following:

1. Direct observation interviews between a researcher and a participant
2. Archival records using public records and documents
3. Documents of written resources
4. Participant-observations in a natural setting for observing and participating
5. Physical artefacts of found objects

The primary source of evidence gathering will be interviews, albeit they are for the primary purpose of having the interviewees respond to a numeric relative to the value of

specific course work. The structure is as open-ended conversations with those identified as industry leaders and academic leaders. This open-ended process will allow for any conversation beyond the numeric answer to the formal structured question. This data-gathering through interviews, according to DeMarrais and Lapan (2004), will be 'a process in which a researcher and participant engage in a conversation focused on questions related to a research study' and as noted above, 'if the numeric response leads to a conversation'.

Another source of evidence will be documents, in the form of literature from educational sources. An analysis of offerings of (1) primary and secondary subjects of graduate institutions specialising in the subject matter and (2) MBA programmes will be done.

The study methods include reviews of institutions involved with product design and/or development and/or innovation management in order to answer the question 'who are they, and how many, and what do they do?' The researcher's own multiple database searches, using descriptive filters have identified the institutions in this space. Comparisons will be limited to the USA-related programme and interviewees only.

Researching the top global MBA programmes (*Financial Times* 2013) allows for analysis to identify common coursework of current curriculum MBA teaching. Research to date, used as a filter, the 2013 *Financial Times* listing, identifying the 'top MBA programmes' and their common core coursework. Data for MBA programmes was available from the Association to Advance Collegiate Schools of Business (AACSB).

3.4 Gathering Data

Gathering the above data from thought leaders in the field (both from industry as well as academia), from alumni of the Northwestern University programme, (which to date has the broadest course offering for the degree), reviewing coursework from institutions offering similar degrees, and studying the coursework of the top MBA programme, will allow for an understanding of what is being taught and what is desired from leaderships' point of view, for the management of product design and development management. The above review may determine a possible new curriculum design more appropriate for industry needs.

Once having developed this curriculum, it is expected that others teaching in this area will recognise the benefits from the current leadership. It is expected that more institutions will modify their teachings and branding to allow for a higher level of recognition in much the same way as MBAs are recognised. In attempting to understand business schools and curricula, the number of schools, and the specific teachings, several accrediting associations are reviewed.

3.5 Accreditation

In order to assure the referenced institutions are recognised as adhering to a high-quality standard, accreditation bodies are referenced. In the USA, accreditation agencies are

recognised for their value both on a national or regional basis, as the schools they accredit are then qualified for federal and state financial aid programmes (All Business Schools, n.d.). The following organisations grant accreditation to institutions of higher learning located anywhere in the USA and abroad:

> AACSB: The Association to Advance Collegiate Schools of Business (AACSB International) grants national accreditation to undergraduate and graduate business administration and accounting degree programmess. AACSB International accreditation is widely regarded as the highest level of accreditation for business schools, as only 25 per cent of U.S. business schools achieve AACSB International accreditation.
>
> ACBSP: The Association of Collegiate Business Schools and Programmes (ACBSP) accredits smaller private and public schools that offer associate's, baccalaureate, master's and doctoral-level business degrees that focus on teaching. The ACBSP's national accrediting standards place an emphasis on how the school achieves teaching excellence through outcomes assessment. The accreditation standards are based on quality and the continuous improvement process.
>
> CHEA: The Council for Higher Education Accreditation (CHEA) is a non-governmental association of 3,000 degree-granting colleges and universities dedicated to maintaining academic quality through accreditation. The CHEA recognises 60 institutional and programme-specific accrediting organisations, such as the AACSB, ACBSP and DETC, as well as regional accrediting bodies (All Business Schools, n.d.)

Additionally, the International Assembly for Collegiate Business Education (IACBE) (n.d.) claims a worldwide following with 239 members, of which 169 are accredited from 1,085 programme . They are recognised by the Board of Directors of the Council for Higher Education Accreditation (CHEA). EQUIS is an accreditation organisation with an objective that is linked to EFMD, the European Foundation for Management Development based in Belgium. The numbers from EQUIS indicate 78 Business Schools in Europe, 25 in Asia, 8 in Oceana, 8 in Latin America, 10 in Canada, and 3 in the USA (EFMD n.d.).

Another organisation that considers itself an accreditation organisation is the Association of MBAs or AMBA. They accredit over 200 business schools in over 80 countries and claim the following:

> Rigorous assessment criteria ensure that only highest calibre programme which demonstrate the best standards in teaching, curriculum, and student interaction achieve. Unlike other business education accreditation bodies, we focus in detail on individual programme rather than whole institutions. Our accreditation is international in scope (AMBA n.d.).

MBA-accredited programmes by AMBA are in the following areas: Europe, 76; Asia, 30; Australia/New Zealand, 30; North America, 30; and Latin America, 30. The largest of the accreditation organisations appears to be the Association to Advance Collegiate Schools of Business (AACSB). They claim they are 'known worldwide as the longest standing, most program form of specialized/professional accreditations an institution and its businesses programs can earn' (AACSB n.d.). They readily admit that less than 5% of the world's 13,000 business programmes have earned their accreditation and make the claim that '95% of surveyed schools reported that AACSB Accreditation is an indicator that their quality is higher than that of non-AACSB-Accredited schools'.

MBA studies are relevant to this study, as MBA course work is management based. Since product design and development management course work is under investigation, it seems obvious to the researcher that an understanding and appreciation of MBA course work is undertaken.

3.6 Filters

In researching design development management type programme , the online search engines (e.g. Google, Findamaster, and Core 77) were used by applying the following keywords for basic filtering: master of design development, master of science in product design development, master of product design development, MBA design, and MBA design development. Over 48 institutions worldwide were initially identified using this review.

A second filter was then applied to establish those design development programme that included management-type classes consistent with core MBA courses. The following eight keywords (see Table 1) were used and were based on common core classes taken from the listing of the top 15 MBA programme in the world, as identified by the *Financial Times* 2013 ranking:

Table 1. Common MBA Core Class Keywords

accounting	ethics	finance	decision-making
leadership	marketing	operations	organisational

Of the top 15 MBA schools (*Financial Times* 2013), fourteen of them offer the same five common courses. Those include finance, operations management, marketing, accounting, and economics. Of the 35 identified institutions offering masters in design and development management type programme , only six offered four or more of the above eight management classes.

In order to have an understanding of basic business courses, the following descriptions were taken from the Stanford Business School course catalogue for the school year starting in 2013. Stanford was indiscriminately chosen, as it was noted as one of the 15 best MBA programme (*US News and World Report* 2016). The following are included as the core coursework in that programme:

- Accounting: understanding and use of corporate financial statements.
- Ethics: analysis of ethical dilemmas and how to deal with the day-to-day basis with the practical issues of ethical behaviour in organisations.
- Decision-making: understanding of what one can and cannot infer from data and how to use those inferences to make good decisions.
- Finance: standard tools and techniques of financial analyses valuation and model building, to include capital structure dilation mergers and acquisitions private equity and venture capital.
- Leadership: focus is on questions such as how do we maximize the performance of the teams we become part of; question what interpersonal skills give us influence.
- Marketing: analysing the needs and wants of potential customers and creating and delivering goods and services profitably.
- Organizational behaviour: helps one to cultivate sets and build skills to understand the ways in which organisations and their members affect each other frameworks for diagnosing and resolving problems in organisational settings.
- Operations: managerial issues arising in the operations of both manufacturing and service industries.

The references cited may be particularly applicable in understanding managerial needs, assuming those are being matched by MBA studies on core classes.

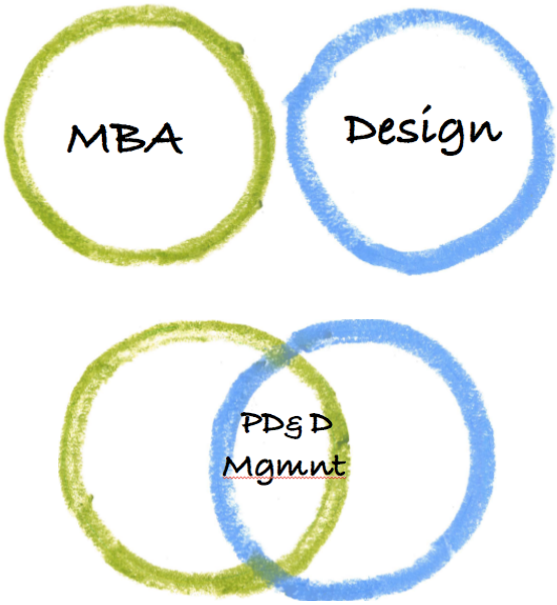


Figure 22: Graphic Representing Two Principal Areas of Study: MBA and Design

The figure 22, above reflects a potential overlap that could produce a newer scholarly discipline in the management of product design and development.

3.7 Mixed Messages

The preliminary research covering institutional teachings in the area of product design and development management recognise a lack of common coursework. To date, no pedagogical studies referring to recommended or optimal coursework for this field of study have been uncovered. Textbooks have been published, however, that address the subject of product design and development.

Schön (1983) notes ‘we look to professionals for the definition and solution of our problems...universities are not devoted to the production and distribution of fundamental

knowledge in general' (vii). He also reflected that 'those who create new theory were thought to be higher in status than those who apply it, and the schools of higher learning were to be superior to the lower' (Schön 1983: 37). Schön believed this thinking became the cause of the split between research and practice.

The underlying foundation on which this research is based recognises the divide between business needs and academic teachings and is in the same manner, as Schön references in 'The Reflective Practitioner'—that is, to attempt to find if a basis of core subjects from a business perspective is required for the teaching of the subject. The literature review does include references to pedagogy, professional practice, and PhD studies. The pedagogy referenced is generally directed to business subjects.

3.8 Research Interview Strategy

Key individuals from a variety of USA corporate enterprises were chosen for interviews. For this sampling, the population includes those involved in the management of product design and development who are either noted as individuals in the field or represent companies that are noteworthy for their design-centric attention.

Telephone interviews are the intended format with senior executive thought leaders, using an open ended method to allow for comments beyond the numeric value for each of the courses reviewed. For clarification, open ended for this definition allows for potential conversation. The 'definitive answers' requested will be a numeric response to a table of 0–10, referencing the values of subject matter. The interview technique

includes a guide, which in this case is a request for a numerical response to the value of discrete courses.

The value in interviewing these thought leaders is their high level of interest in the subject matter, as all recognise their own organisation successes come from product design and development supported by strong management. The thought leaders interviewed all understand the area of interest and all have an agenda of improving and growing their own professionals within the organisations.

They have been selected using the following criteria. All have sensitivity to design and design thinking and have presented themselves as either speakers or authors on the subject. All have leadership roles in organisations that have sensitivity to the value of design as a competitive advantage and have the ability to influence design direction and decisions within their organisations. The leadership roles include the titles of Chief Executive Officer (CEO), President, Senior or Vice President, Director, General Manager, and Chief. All have a depth of experience in leadership of design-centric organisations.

3.9 Research Background

The interviews held were in accord with Bingham and Moore (1941), in that interviewing is fundamentally reduced to 'fact finding, informing, and motivating...One wishes to interview and to learn from the interviewee, or to tell the interviewee something or to influence their feelings or behaviour'; they go on to state, 'the research interview is a "conversation with a purpose"'. The structure as noted earlier is a telephone interview following the interviewee's receipt of a questionnaire explaining the subject matter, and reviewing all course work offered by all institutions. The interviews proceed by having the interviewee respond with a numeric relative to their agreement or disagreement relative to the value of each course reviewed.

Bradburn *et al.,* (2004) recognise the only reward for the interviewee is the experience of having their opinion heard and possibly the chance to participate in an experience that others will benefit from. They note that in designing the questionnaire, one has to be sensitive to the recognition that some number of questions should be of interest when, and if, dealing with subject matter that may not be of *high* interest. For the questionnaire component of this thesis dealing with a 'conversation with a purpose', the individuals interviewed were all known to the researcher either through the professional world or the academic world. As such, the conversations were thoughtful and purposeful.

The participants had full knowledge of the subject, and all are involved in the field of product design and development management. Since all have an interest, the expectation was one of unbiased response, as all want to advance the education of those managing the process. Respondents were asked for informed consent (examples are in the

appendices) and if their names could be used. None of the interviewees requested anonymity.

All respondents were asked to review and sign a consent document. The consent form allowed them to withdraw from the study during any time the study was taking place and without having to give a reason. Should they withdraw, their information to date would be destroyed. The consent form also had a date of withdrawal of up to six months following completion of participation. It was noted that the work was authorised for my efforts as a PhD candidate under the auspices of Coventry University, Department of Art and Design, and was being supervised by Dr David Durling, and was noted as such.

3.10 Designing the Questionnaire

In designing the questionnaire, strong consideration has been given to the basic question 'what information will be transmitted that will be of importance for this study?'

It is also important, according to Bradburn *et al*., (2004), to appreciate that for some questions, albeit non-threatening questions, the respondents could have concern for truthful answers that could put them in a bad light and thus such questioning that might be perceived as threatening and disrupt the interaction between the respondents and researchers. The effort could be considered grounded theory, as there was no hypothesis suggesting industry leadership was the driving force behind the teaching of various courses, for the subject of product design and development management. Grounded theory according to Grix, (2010) can be "understood as an attempt to close the gap between theory and research by 'grounding' theory in empirical data…[and] does not

start out with a hypothesis, but develops them after collecting data" (2010: 112). In the case of this study, the review of course work taught in institutions offering a degree in product design and development management was reviewed; opinions as to what courses should be taught was then collected from academic leadership responsible for these programmes; and senior leadership was queried as to what they perceived one should have received upon receiving this degree to be of value for their management needs.

The list of interviewees for the design-centric industry professionals can be found in Appendix D.

The list of interviewees for educational institutions can be found in Appendix E.

3.11 Risk Management

There are some risks that can impact this effort. Albeit there may not be a large number albeit the risks could be considered by some, significant. In order to achieve the purpose of understanding what industry leaders believe to be an appropriate teaching core for the next generation of leadership in product design and development management, a degree of consensus is required for core subjects. The above listing of 20 notable interviews is, by definition, qualitative in nature and could be considered by some to be on the low side. However, the consensus mitigates that concern, as there is a good degree of unanimity to the recommended subject matter.

3.12 Chapter Conclusion

The chapter clarifies ‘leader’ as well as design-centric organisations as those that employ user-centric methods, empathy, and empowerment for the solving of problems. Reference is made to Archer (1995) for inquiry with a goal of communicable knowledge that is systematic, finds answers to questions, and is goal directed and communicable, investigating institutions for an understanding of what they teach as subject matter and what the leaders of those institution believe should be taught, followed by understanding what industry leaders believe to be most relevant in terms of core competency.

An institutional overview referencing 28 different degrees is presented, as is the introduction of 35 different programmes. Programmes were explored using basic filtering as follows: master of design development, master of science in product design development, master of product design development, MBA design, and MBA design development.

The epistemology is reviewed using purposive sampling and questionnaires supported by one-on-one, open ended conversations. Identical questionnaires were also sent to 90 respondents, all graduates of the Northwestern University product design and development management programme.

Whilst the programmes in question do not have an accreditation affiliation or association, business schools in general were reviewed for accreditation. That accreditation lies with AACSB: The Association to Advance Collegiate Schools of Business (AACSB International), ACBSP: The Association of Collegiate Business

Schools and Programs (ACBSP), and CHEA: The Council for Higher Education Accreditation.

In attempting to summarise this chapter on Methods and Methodology, the work by Schön (1983: 39) is acknowledged

> "From the perspective of technical rationality, professional practice is a process of problem solving. Problems...or decisions are solved through the selection, from available means, of the one best suited to establish ends...In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain…He must make sense of an uncertain situation that initially makes no sense".

Thus multiple research studies have been chosen to offer a more complete understanding of the subject.

Chapter 4: Results

4.1 Overall Results and Broad Analysis

This chapter reviews the findings of the research. It includes a listing of institutions, incorporating a master's programme in the field of product design and development management, coursework, and interviews with leadership from both academia and USA corporate enterprises. The naming of the individual graduate programmes is presented for clarifying that there is no one common name. The chapter involves the following sections:

A. Data Base Research: Review of worldwide institutions that make claim to master's degree education in the general field of product design and development management. Additional data base research is included for business school courses.

B. Questionnaire:

   Review of the opinions of leaders needs (which could be noted as 'wants') in USA design-centric organisations in terms of hiring for the role of manager of product design and development and skills required. Two separate questionnaires were used, with an interval of 6 months time.

   Review of the opinions of academic institution leaders, within the USA, for design development management degrees, relative to recommended coursework and naming of the degree

   Review of the opinions of alumni from one design development management programme, regarding the value of coursework available throughout the world in this field

4.2 Section A: Data based research

Using keywords that include product, development, integrated, design, management, innovation, strategy, product, services, leadership, MBA, strategic, industrial, arts, and engineering—and combining those words with the general subject of master's degree, 35 international institutions were identified. Multiple combinations of those words were used in combination with the word 'master's' or 'master's degree'. Of those, 17 were identified as USA-based. Online searches were combined with review of programme literature, confirming the degree as well as the coursework offered.

4.2.1 Identified institutions

The following institutions met the base requirement of having a formal degree associated with some combination of the prior listing of keywords, confirmed by review of coursework and syllabi. The 35 institutions offering a degree relative to product design and development management were developed into a spread sheet. Included is a review of degrees and coursework.

The list delineates between: UK, Europe and USA and are in alphabetical order.

The researcher believes the following are all of the institutions in the world that meet the base qualification of having a name describing the overall subject of product design / innovation development and/or all variations, based on name and course work.

UK institutions:

Aston University
Birmingham City University
Bournemouth University
Brunel University London
Cardiff School of Art and Design
Lancaster University
University of Glasgow

University of Liverpool
University of Warwick

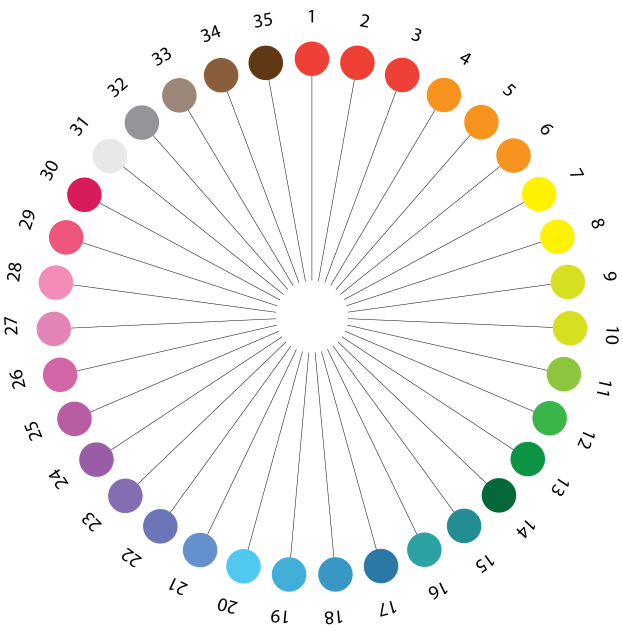
European and Scandinavian Institutions:

Barcelona School of Design & Engineering (ELISAVA)
Chalmers University of Technology
IED Barcelona
International Hellenic University
KTH Royal Institute of Technology
TU/e Technische Universiteit Eindhoven
University of Applied Sciences Upper Austria

North American Institutions:

California College of the Arts
Carnegie Mellon University
Cranfield University
Institute of Design IIT
Kendall College of Art & Design of Ferris State University
Maryland Institute College of Art
Milwaukee School of Engineering MSOE
Massachusetts Institute of Technology (MIT) SDM (System Design & Management)
Northwestern University
Parsons The New School of Design
Philadelphia University
Pratt Institute
Rochester Institute Technology
San Francisco State University.
SCAD (Savannah College of Art & Design)
Schulich School of Business (York University)
University of Detroit Mercy
University of Penn (UPenn)
Virgina Commonwealth University da Vinci Center

The following graphic, figure 23, is a visual representation of all institutions offering a degree in the general area of product design and development management



1. Chalmers U of Tech MSc P Dev
2. Rochester Inst Tech MSc P Dev
3. University Detroit Mercy MSc P Dev
4. Brunel Univ. London MSc Integ PDsgn
5. KTH Royal Inst or Tech. MSc Intrg PDsgn
6. U Penn MSc Intel P Dsgn
7. Bournmouth University MSc P Dsgn
8. Cardiff School of Art & Design MSc P Dsgn
9. Northwestern University MSc PDDM
10. University of Warwick MSc PDDM
11. Aston Universtiy MSc PDsgn Innov
12. Calif. College of the Arts MBS Dsgn Strat
13. Carnegie Mellon M of Integ Innov for Prod & Serv.
14. Cranfield Univ. M of Dsgn in Dsgn, Strat & Ldrshp
15. Virginia Commonwealth M of Prod Innovation
16. IED Barcelona M Dsgn Mgmnt
17. Inst of Design IIT (Ill Inst Tech) M Dsgn MBA
18. Intl Hellenic Univ. MSc Strat Prod Dsgn
19. Kendall Art & Dsgn MBA Cert in Dsgn & Inn Mgmnt
20. Lancaster Univ MSc International Innov (Dsgn)
21. Maryland Inst College of Art MBA / MA Dsgn Ldrshp
22. Milwaukee School of Eng. MSOE
23. MIT MSc Integrated Design & Managment
24. Parson's New School Dsgn MSc Strt Dsgn & Mgmnt
25. Philadelphia Univ. MBA Strategic Dsgn
26. Pratt Intl MPS (M rof Studies) in Dsgn Mgmnt
27. San Francisco State Univ MA in Indust. Arts
28. SCAD (Savanah Schl Art Dsgn) MFA Dsgn Mgmnt
29. Schulich Schl of Bus (York Univ) MBA/MFA
30. Tu/e Technische Universiteit Eindhoven MSc Innov Mngmt
31. U of Applied Sciences Upper Austria MSc Innov & Prod Dsgn
32. U of Glasgow MSc Prod Dsgn Eng
33. U of Liverpool MSc (Eng) Prod Dsgn & Mgmnt
34. Birmingham City Univ. Dsgn Mgmnt MA
35. Barcelona School Dsgn & Eng (ELISAVA)

Figure 23. Institutions with a Master's Degree in the General Area of Product Design and Development Management.

In the figure 23 above, the same colours indicate the same named programme . The colour-coding shows those institutions with the same branding name for their programme.

4.2.1 Master's Degree Names

The 35 institutions have minimal commonality relative to the naming of their individual programme . Every programme's name included a combination of one or more of the following words: product, development, integrated, design, management, innovation, strategy, product, services, leadership, MBA, strategic, industrial, arts, engineering. The degrees using some combination of the above are noted and ultimately developed into 28 separate degree names.

At this point in time, of the 35 institutions teaching the broad subject matter of product design and development management, 24 different master's-named degrees are awarded. Four schools share the same programme name, albeit they all have a different prefix, including: MA, Master, MFA, and MPS. Six schools share two degree names whilst four schools share two other named degrees.

The greatest commonality of basic names is used by four schools with varying prefixes with the basic name being 'Design Management'. Two different names are used by six different schools, and two names are shared by four institutions. The most popular name, 'Design Management', is shared as follows:

- MA Design Management, Lancaster University
- Master in Design Management, IED Barcelona (Spain)
- MFA Design Management, SCAD
- MPD (Master in Professional Studies) in Design Management, Pratt Institute

The next two most popular degree names shared by three schools are

1. Master of Science in Product Development, shared equally by Chalmers, Rochester institute of Technology, and University of Detroit Mercy; and
2. Master of Science in Integrated Product Design, shared equally by Brunel University of London, KTH Royal Institute of Technology (Sweden), and University of Pennsylvania.

The next two most popular commonality of names, with two schools each, are

3. Master of Science in Product Design and Development Management, shared by Bournemouth and Northwestern University; and

4. Master of Science in Product Design, shared by University of Warwick and Aston University (UK).

Additionally, 25 individually named degrees are used for the remaining 25 institutions. Whilst there is a relationship between all the names, the lack of a common brand, similar to MBA (Master of Business Administration) or MEM (Master of Engineering Management) mitigates the potential value.

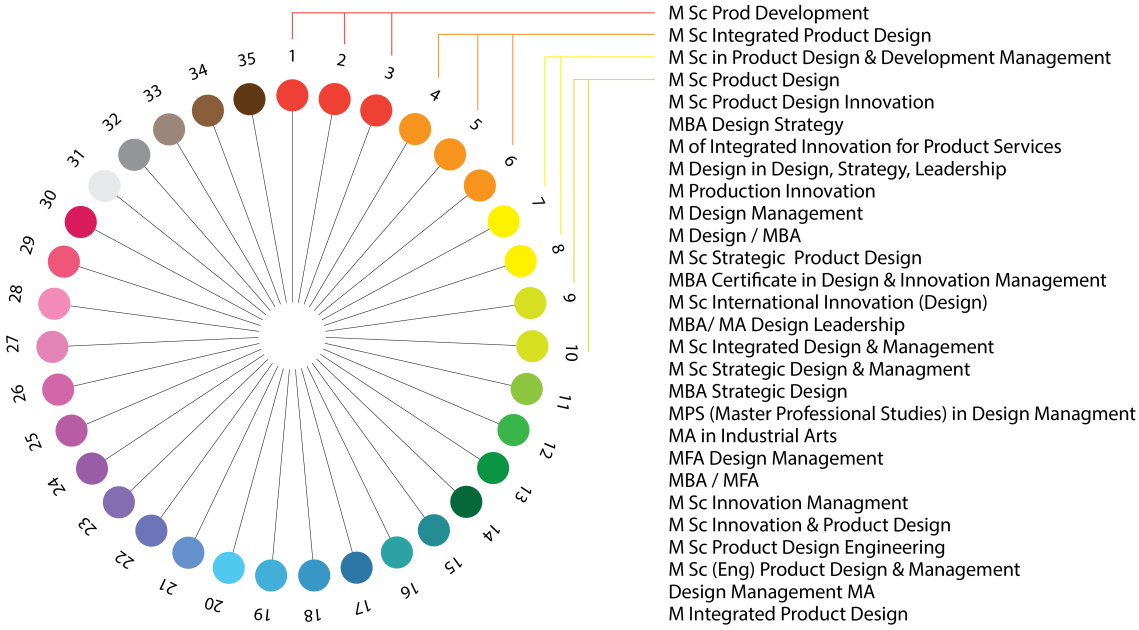


Figure 24: The top four programme degree names are most common amongst institutions.

The figure 24, above references the 29 separate degrees awarded amongst the 35 institutions offering a master's in product design and development and is developed to allow for a more visual appreciation of the lack of common names and the range of individual named programmes.

4.2.2 Coursework taught

Once having identified the institutions, the program' coursework offering was explored. In understanding course work from the various institutions, common naming of coursework was instituted. An example included the description of the course 'Organizational Behavior', as upon review of similar syllabi, it was possible to recognise that the descriptor of 'Team Building' and/or 'Managing Teams' would also be 'Organizational Behavior'. Thus, variation of names were combined under one name for efficiency and better understanding.

The following 3 tables, numbered 2; 3; and 4, name the 56 separate and discrete subjects taught in the respective curriculums involved in product design and development management. The below listings are limited to those programme with two or more institutions teaching the subject.

The 'secondary name' shown are another descriptor, however the course work appears to remain similar as interpreted by the researcher. As such, the researcher, by virtue of reading the published course descriptions, assigned the 'popular' primary name, with the secondary name noted. The course work is divided into the following 3 categories for an easier reference. The categories represent the colleges, and/or program, that are often involved in the teaching of the individual subjects, and include; Design; Business; and Engineering. The third column is a general description of the course work derived from a review of multiple syllabi and or marketing material.

Table 2. Business course work

Popular Name	Secondary Name	Description
Accounting		Financial reporting statements, budgeting, cost accounting, variable costing
Advertising	Promotion	Advertising is the controlled paid messages in media; promotion includes paid and free marketing
Business and Capital Markets	International Environment of Business	Understanding markets for buying and selling of equity and debt instruments for financing
Business Fundamentals / Design Management	General Management	workings of a business to include principles and practices; understand marketing, strategy, creation of goods and services
Business Law		The understanding of the law and the regulations that apply to businesses
Communications		Written and oral communications to include reports, presentations, e-mails and memos
Decision Making		Probabilistic concepts
Economic Analysis/Game Theory		Understanding micro and macroeconomics to include game theory for decision analyses showing alternative solutions
Entrepreneurship	Business Planning; New Venture	Designing, launching, and running a new business
Ethics / Leadership	Regulatory	Building trust, credibility, and respect; understanding core values; ethics and leadership; understanding regulations
Finance		Capital markets
International Studies	Cultural Relevance	The study of political, economic, social, and cultural issues within the international community
Investment		Valuation and investment to include stocks, funds, bond and portfolio management
IT Management	Information Design/Information Systems	Project management dedicated to Information Technology
Managing Innovation and Change		Successfully innovating in a repeatable fashion
Market Research		Applying various techniques in order to gather needed data of markets
Marketing		Understanding segmentation, targeting, positioning and packaging of product or services
Negotiation		Understanding win-win
Operations	Project Management	Analyses and improvement of business processes in service or in manufacturing
Organisational Behaviour	Managing Creative Behaviour, Teams	Understanding corporate culture, mentoring, behaviour
Product Lifecycle		The stages a product goes through until it reaches market; to include post usage and recycling
Project Management	Operations	The application of knowledge, skills, tools and techniques to meet project requirements
Research Methods		Various methods for understanding and collecting data
Risk-Benefit Analysis		Understanding the comparison between the risk of a situation and its benefits
Service Management		Intersection between the sales and the customer
Social Ventures		Identifying entrepreneurship to solve social and environmental problems
Statistics	Obtaining Meaning	Visual ways to describe and optimise product performance.

	from Data	estimating reliability of products
Use of Strategic Technology		Strategy that applies to understanding where a company is, and where they choose to be

Table 3. Design course work

Capstone	Thesis/Major project	Coursework identifying opportunity, design, engineering, manufacturing costing and understanding supply chain; to include financial modeling
Design Protection	Intellectual Capital Strategy	Understanding copyrights, trademarks, secrets and patents
Design strategy	Branding	Understanding culture of innovation, collaboration, design language, ethnography, futures and optimisation of performance
Design/Applied Theory	Design Science	Focus on various levels of research for the study of design
Forecasting	Design Futures	Exploring the future to include transport issues, social and environmental impact; imagining the future
Global product design		Understanding international issues in design, using disparate centres for product design success
History of Product Design	History of Contemporary Product Design	Understanding history of the industrial design profession to include more current history
Human Factors		Designing product, systems, or processes taking account of human interaction
Industrial Design	Industrial Design Engineering	The process of design as it is applied to products for manufacturing
Innovation	Creativity	Thinking out of the box, tools for creativity and innovation, brainstorming
Introduction to Product Design and Development	Foundation, Intro to Product Design	Overview of the process of design development
Philosophy of Design	Theory of Design	Scholarly inquiry into design
Problem Framing		A set of concepts emphasising focus on the problem definition
Sustainable Development		Meeting the needs of business without comprising the environment
Theory of Product Design	Methodology of Product Design	Methods, strategies, research and analysis of design
Visual Communication	Drawing, Sketching	Understanding basic concepts to allow one to express concepts in a visual format

Table 4. Engineering course work

Advanced CAD		Advanced concepts in computer assisted design based on computer programmes
FE Simulation		Using computer software to understand finite elements of structure

Introduction to Engineering Design	Integrated Engineering Design	Basics of mechanical engineering
Machine Shop/Rapid Prototyping		Understanding basic machine tools including mills, lathes, water jets, laser cutters. Understanding rapid using printing and stereolithography
Manufacturing	Lean Design	Understanding production design, manufacturing methods, optimisation techniques
Material Selection		Understanding material properties, methodology and procedures for material selection
Micro Electric Consumer Products		Design of electrical and electronic systems using CAD tools for micro-miniaturisation
Software Engineering		Design, development, maintenance, testing and evaluation of software systems
Software Management		Overview of process to include waterfall methods with realistic plans
Supply Chain	Global Product Design	Activities and processes involved in production and distribution
Systems Design and Optimisation	Systems Management	Understanding advanced and complex engineering systems
Systems Management		Generally referred to information technology management

A spread sheet is included in appendix A, (reduced examples below) and was developed to assure accuracy and to better ascertain the duplication of any one course within the listing of 35 institutions.

	A	B	C	D	E
1	schools	degree	course work		
2			Processes		
3			Innov P Dsgn or		
4			Intro to PD &D	Commucations	Org Behave
5	Aston University	M Sc Prod Dsgn Innovation	X		
6	Barcelona School of Dsgn & Eng ELISAVA	M Advncd Dsgn Mnmngt; Strat & Entr			
7	Bournemouth University	M Sc Product Design	X		
8	Birmingham City Unviersity	Design Management -MA			
9	California College of the Arts	MBA in Design Strategy	X	X	X
10	Cardiff School of Art and Dsgn	M Sc Prod Dsgn	X		
11	Carnigie Mellon Univ	M of Integ Inn for Prod &Services			
12	Chalmers U of Tech	M.Sc. Prod Devel	X		
13	Cranfield Univeristy	M Dsgn in Dsgn, Strat, ldrshp		X	X
14	Virgina Commwealth U. da Vinci Ctr	M Prod. Innovation	X		
15	HK PolyU School of Dsgn	Mof Design Design Practices			
16	IED Instituto europeo di design	M Strategic Dsgn			
17	Institute of Design IIT	M Dsgn / MBA	X		
18	Intl Hellenic University	M Sc Strategic Prod Dsg			X

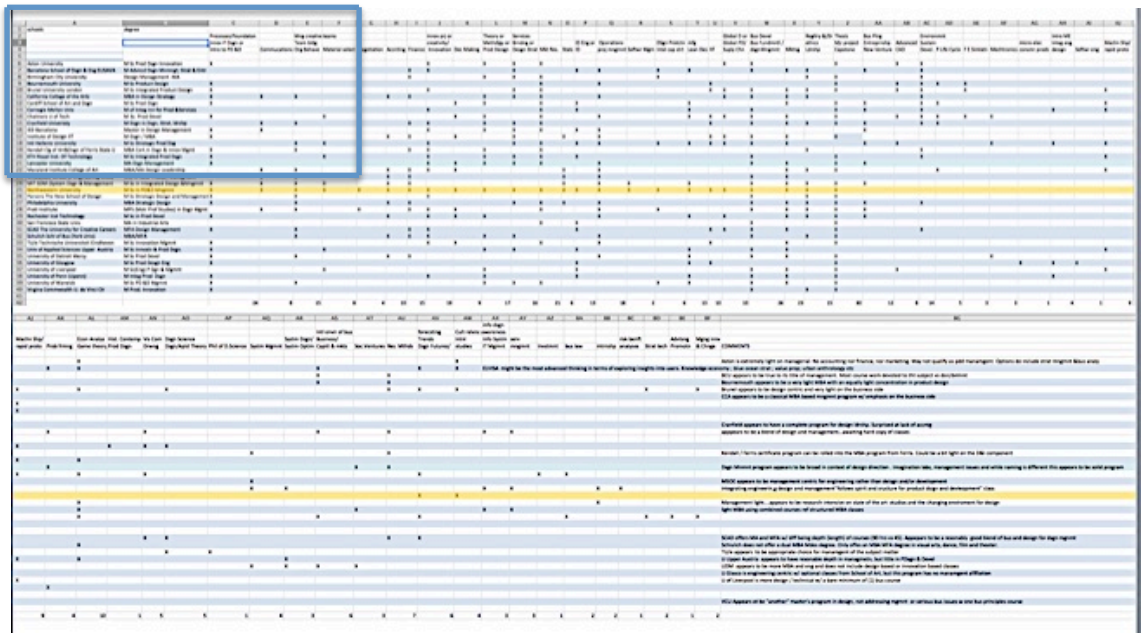


Figure 25: Spread sheet Image showing an enlarged section (top) to include all Institutions and Classes)

Figure 25 is a representation of the spread sheet developed referencing all 35 institutions and all classes taught within those institutions relative to their master of product design and development type management degree. The entire spread sheet is shown in the bottom image, albeit, it is shown in 2 horizontal sections, rather than one long spread sheet, however the full sheet is in Appendix A. The upper of the 2 images, shows an enlarged section of 18 of 36 horizontal rows and 5 of 70 columns. The most taught classes had a high of 23 institutions teaching the same class and a low of only one institution teaching a specific subject.

The following graphic indicates 35 institutions referencing the 11 most common classes. Of the 11 most common, 14 institutions have the same course whilst the most common class (capstone) is shared by 23 institutions.

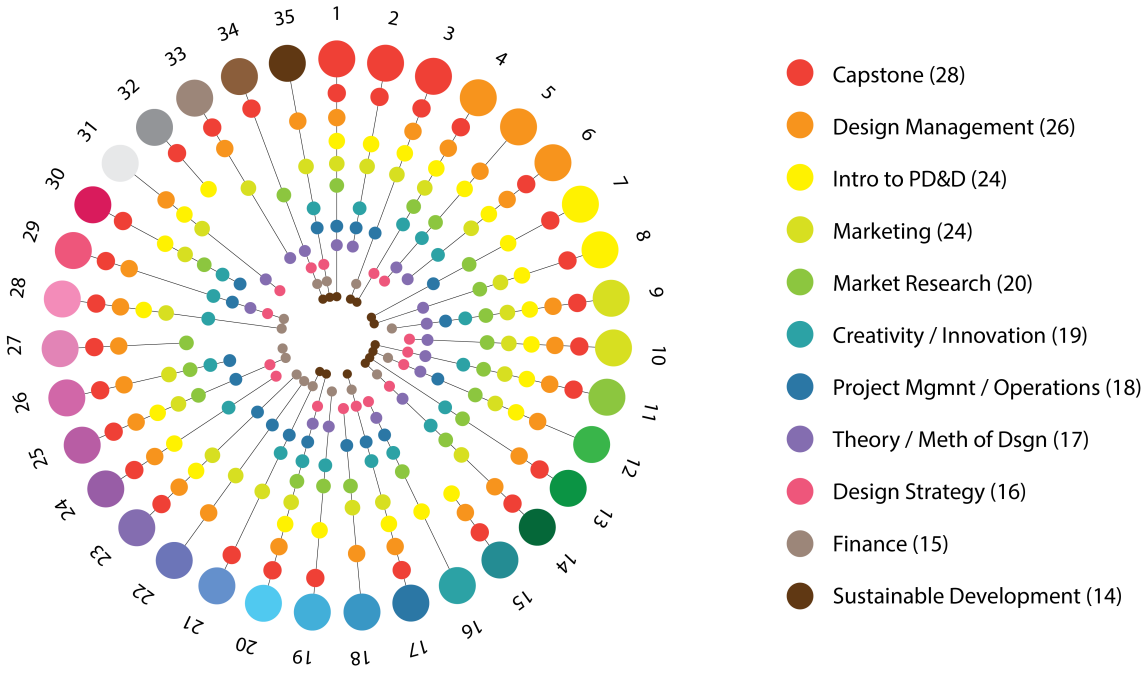


Figure 26: Common Courses.

Figure 26 shows 35 institutions and the 11 most common courses amongst the 35. The coloured dots reference the individual courses per institution. A spread sheet (Appendix A) included in the appendix (sample above; see Figure 26) was developed to analyse and synthesise the published data from the 35 institutions. Each university's courses were noted. The spreadsheet of institutions is used to synthesise the information within this document.

4.2.3 Business School Comparisons

All programmes offering master's degrees in product design and development management do so with the inclusion of some business courses. Those business courses are similar or identical to teachings from institutions offering advanced degrees in

business, normally noted as MBA, or Master of Business Administration. As such, the introduction of business school offerings is of importance to this study.

4.2.4 Business school overview

In reviewing accreditation agencies for MBA programme , it is difficult to ascertain an accurate number of institutions offering the degree. The Association to Advance Collegiate Schools of Business (AACSB) (2013) claims they are the most recognised of the educational associations and reference institutions awarding MBA degrees, of which there are 4000 business schools. Fewer than 5% have earned accreditation, according to AACSB.

According to FIND MBA (n.d.), in Europe alone there are 399 MBA programmes whilst in the USA they identify 784 institutions with another 443 in Asia, another 53 in Australia and New Zealand, and Canada/Latin America numbering 130, with Africa and the Middle East numbering 89. The total comes to 2,034 who reward the graduates with the MBA degree.

The Financial Times' offering of top-ranked business schools of 2013 lists 15 institutions that offer a master's degree in business (MBA) whilst there are approximately 13,000 business programme (AACSB 2013) worldwide. The top-ranked schools worldwide, as noted in the Financial Times 2013 report, are as follows:

Harvard Business School
Stanford Graduate School of Business
Wharton University of Pennsylvania
London Business School
INSEAD

LESE Business School
Hong Kong UST Business School
MIT/ Sloan
University of Chicago
Booth IE Business School
University of California at Berkeley
Hass
Northwestern University
Kellogg
Yale School of Management
CEIBS (China Europe International Business School)

The above are noted for the sole purpose of understanding their basic core classes and if they relate to business-based classes for product design and development management programme . The initial basic hypothesis is that product design and development management programme would include some numbers of MBA classes. In addition to noting the required business courses taught, additional interest is in determining any commonality of coursework.

4.2.5 Coursework Amongst Institutions

In the survey of MBA-type programmes, one finds a more coherent listing of coursework, as opposed to the diversity of coursework for programmes specialising in MPD type teachings. The more consistent courses for the top 15 MBA programmes indicate a tighter focus on core curriculum than exists in the MPD type programme . The MPD type programmes have an expected larger divergence based on the need for management as well as design development types of classes. The most consistent coursework amongst the top ranked (above) institutions include the following:

Accounting	Ethics	Finance	Decision-making
Leadership	Marketing	Operations	Organisational behaviour

Of the 15 top-rated schools, 14 of them offer the identical five subjects. Those include finance, operations, management, marketing, accounting, and economics.

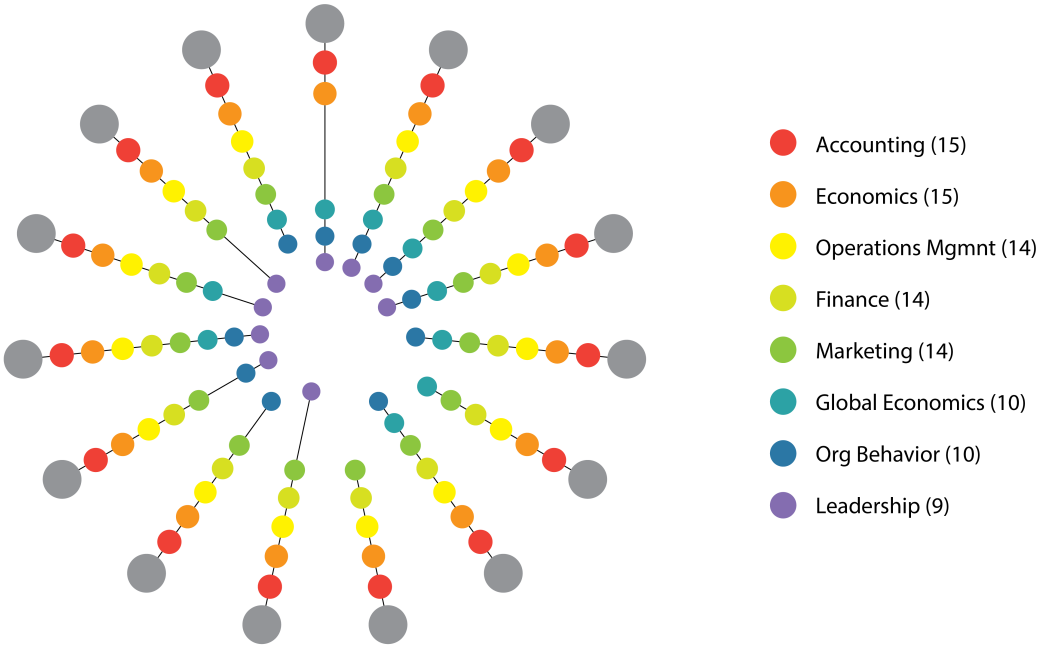


Figure 27: The top 15 MBA Programme (as Referenced by the *Financial Times* 2013)

Figure 27 is a graphic representation of the top 15 MBA programme in the world as referenced by *Financial Times* (2013) and the commonality of coursework.

Of the 15 top-rated MBA programmes , common subjects are as follows:

Accounting	15
Finance	14
Operations Management	14
Economics	14
Global Economics	10
Organisational Behaviour	10
Leadership	9

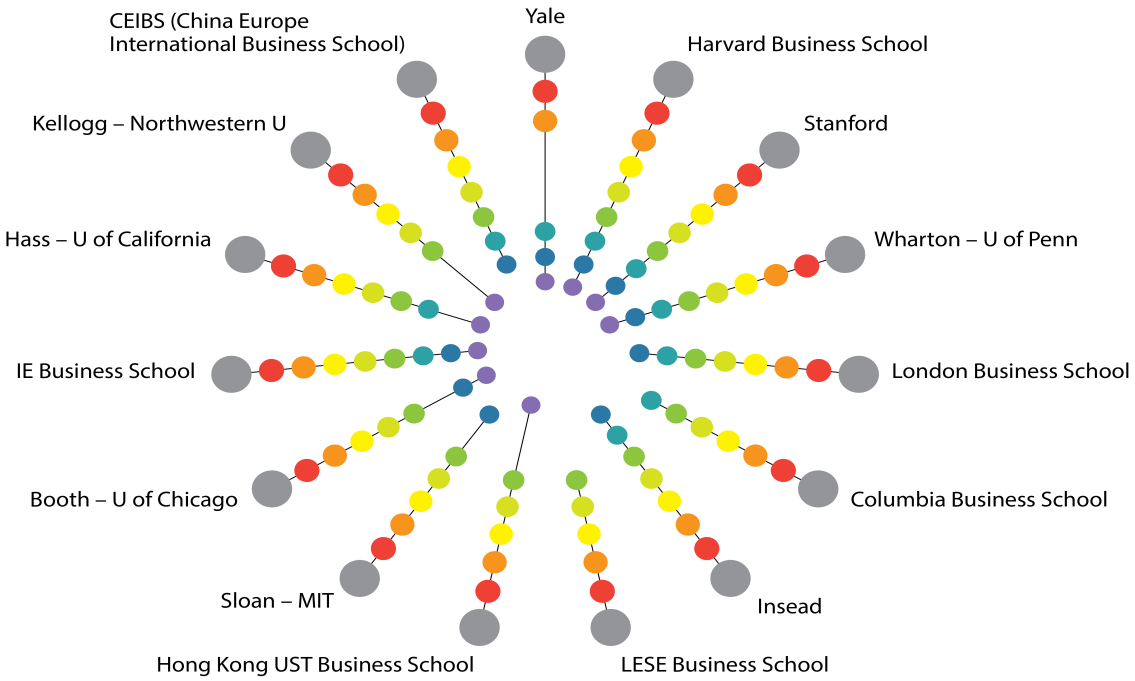


Figure 26. Top 15 MBA Institutions and 8 Common Classes Taught

Figure 28 is a graphic representation of the top 15 MBA awarding institutions and the eight common classes taught.

4.3 Section B: Questionnaire

Questionnaires were developed for 3 different groups. Those being: design-centric industry leaders academic leadership and an alumni questionnaire from Northwestern University programme (see appendix F; G). The industry leader questionnaire was a 2 part questionnaire sent 6 months apart. The initial questionnaire was dedicated to all programmes taught in all schools (see Appendix G). The follow-up questionnaire was dedicated to the top ranked courses only, based on the prior questionnaires results (see appendix H).

The study is considered purposive sampling, as all are intimately involved with design and development management, all are dedicated to the subject, and all are knowledgeable experts (Tongco 2007: 147).

4.3.1 Design-Centric Industry Leaders' Preferences

An initial questionnaire for understanding needs of design-centric industry leaders was developed. Twenty design-centric industry leaders were selected. The researcher prior to the interview process, knew all subjects as either professional colleagues, clients, board of advisor relationships, or general acquaintances through professional activities. All subjects gave permission prior to the formal beginning of the recorded interview and all allowed for their names to be published. Two questionnaires were given, the first of which included a query of all 68 courses from the 35 institutions awarding master's degrees in product design and development management types of programmes. The second was dedicated to the highest ranked based on the original list. The 20 respondents, represented many international companies with headquarters throughout the United States, and of those questioned there were 15 men and 3 woman. Their titles, and partial backgrounds are as follows:

VP Global Merchandising and Marketing, The Coleman Company
Former positions include
VP Product Development, Dick's Sporting Goods
President, Focus Products (a consumer home products company consisting of 15 different brands)
Director of Marketing, Newell Rubbermaid

Design and Innovation Leadership, Proctor & Gamble
Former positions include
Design Director, Procter & Gamble
Director of Learning & Development
Proctor & Gamble Associate Design Director

Director, Insight & Exploration, Herman Miller
Former positions include
Executive Committee member, Office of Ergonomics Research Committee

Director of R&D, Becton Dickenson
Former positions include
Director of R&D, CareFusion
Director of R&D, Cardinal Health

VP, Operations Excellence, SC Johnson
Former positions include
VP, Research and Development, SC Johnson
VP, Global Quality, Wrigley Company

Head of Design, Asia 3M
Former positions include
Design Officer, Consumer Business Group, 3M
Head of Global Design, Consumer & Office Business, 3M
Senior Design Manager, 3M

President, Kitchen & Bath Americas, Kohler Co.
Former positions include
Executive Vice President, Kitchen & Bath Americas, Kohler Co.
President, Weitz Industrial Segment,
Weitz Company President, Hirsh Industries

VP, R&D, S&C Electric Company
Former positions include
Executive Vice President

Senior VP of Innovation, Maddock Douglas
Former positions include
VP of Innovation, Maddock Douglas
Innovation Director, Maddock Douglas
VP, Product Development and Practice Manager, Theikos

Director, Alcatel-Lucent
Former positions include
Sr Manager/Director, AT&T (American Telephone)

Director, Mission Assurance, Northrup Grumman
Former positions include
Senior Manager

Chief Technology Officer, VP, IDEXX Laboratories
Former positions include
VP, Instrument R&D and Manufacturing, IDEXX Laboratories
VP, R&D Assays and Instrument Systems, Corporate Officer, Abbott

Chief Scientific Officer, Sr. VP R&D, Hospira
Former positions include
VP, Global Development, Schering-Plough
Senior Director & Group Leader, US Medical Oncology, Pfizer Inc.

Design Director, Center for Innovation, Mayo Clinic
Former positions include
Associate Professor, Industrial Design, Rhode Island School of Design
Principal Research Scientist, MIT Media Lab
Design Lead, Motorola, Inc.

General Manager, Global Design, General Electric Healthcare
Former positions include
Associate Director, Global Design Organisation, P&G
VP New Product Development, Newell Rubbermaid
Director, Design, Motorola

General Manager, Car Operations, Daimler-Chrysler
Former positions include
Executive VP, Product Development and Design, Chrysler Corporation
Director of Design, Chrysler Corporation

CEO, Logitech
Former positions include
President, Logitech
President, Whirlpool Corporation
President, Proctor & Gamble

VP, Innovation, Wrigley
Former positions include
VP, R&D, Mars Petcare US

President and CEO, Harley-Davidson
Former positions include
President and COO, Harley-Davidson
President and Managing Director, MV Agusta Motor S.p.A.

Sr. VP, Consumer Experience Design, Motorola, a Lenovo Company
Former positions include
Director of Strategy, Sapient
Director of Design, Sony Corporation

The 15 following courses on a scale of 0 – 10 were ranked 8 to 9, with the high and low outliers removed. Outlier removal is based on writings by Freka and Hopwood (1983)

who recognised that outliers decrease precision. They reference Cochran (1963) who suggests extremes should be removed to reduce the skewing of results.

The basis for the 0-10 interval scale beyond the more standard Likert five- or seven-point scale is that the expansion increases scalability (Cummins and Gullone 2000) and in the case of the interval scale, there are exact differences which are known between numbers. The 0-10 scale is more fully described in chapter 5 however it should be noted the following scales were reviewed for appropriateness. Nominal, ordinal, interval, and ratio. A review (My Market Research Methods 2015) clarifies as follows:

- Nominal: In 'nominal' there are no qualitative values, as only 'labels' or names are applied; i.e., 'what is your gender, what is your hair colour, etc. with choices supplied (brown; black; blonde; grey; other).
- Ordinal: The value of the order is important but the differences between each are unknown. Ordinals suggest 'order', thus a question could be asked regarding 'how do you feel', with ordinal answer including; 1. Very Unhappy; 2. Unhappy; 3. OK; 4. Happy; 5. Very Happy. These are non-numeric and the mean cannot be defined.
- Interval: An order is known, as they are numeric, and thus the exact differences are known between the values. The researcher assumes the participant believes increments are equal. As an example, in the 0–10 scale used for the researchers questionnaires, the difference between 8–10 is believed by the participant to be the same difference as between 6–8. Another example is the Celsius temperature, as the difference between values is identical. Thus, 50–60 is a measureable 10 degrees and is identical to 70–80 degrees, which also measures 10 degrees. The word 'interval' means 'space in between'. *Merriam-Webster* dictionary (Interval n.d.) notes the

definition as ‘a set of real numbers between two numbers either including or excluding one or both of them’.

- Ratio: Ratio scales give exact values between units and in that regard are the same as interval scales but with the addition of an absolute, with a defined value of ‘0’. An example of a ratio scale is a scale measuring height or weight.

Based on the above, the interval scale appears to be most appropriate from the researcher’s point of view.

Of the 68 courses presented in the questionnaire, the following were deemed to be most important, based on the opinions of design-centric industry leadership.

Capstone
Communications
Cultural Differences
Design Futures
Human Factors
Industrial Design
Innovation
Leadership
Lean Manufacturing
Methodology
Overview
Problem Framing
Research Methods
Strategy
Supply Chain

4.3.2 Academic Leaders’ Preferences

Individuals with academic responsibly as either deans, department chair people, directors, or associates were interviewed using the same basis as those representing corporate leaders. Top scoring programme for academia, using the same scale of 0–10, resulted in the following that received 8–10.

Capstone
Communications
Decision-Making
Entrepreneurship
Ethics
Innovation
Leadership
Overview
Problem Framing
Product Life Cycle
Research
Research Methods
Strategy
Systems Management

Marketing

The range of 8–10, representing ‘important’ to ‘most important’, was guided by Robert Schaeffer, Senior Lecturer of Marketing specialising in design research at the Kellogg School of Management at Northwestern University.

4.3.3 Academic comparisons relative to industry leaders response

Both corporate leaders’ and academic leaders’ opinions reveal a belief in the values of specific coursework for one entering the area of management within the field. Those who are teaching note the above opinions of coursework to be of the greatest value. Irrespective of the above, upon study of actual course curriculum as shown in the various marketing materials and syllabi, there is not a direct comparison to the apparent teaching of the subject matter versus those courses deemed most important.

As a matter of highest value, or ‘importance’, in the opinions of leaders in academia, the following were selected:

Overview of the Subject Matter	Innovation
Decision-Making	Decision Strategies
Decision Strategies	Ethics
Leadership	Capstone Development
Problem Framing	Research Methods

Whilst corporate leaders’ opinions reference those of ‘importance’, there is disparity, as academia does not consider those same subjects in that category.

4.3.4 Alumni Preferences

A survey was sent in the spring of 2015 to approximately 360 alumni from the Northwestern University Master of Product Design and Development Management programme. All students were involved in the product design and development field prior to and during their master's work. Statistics for the alumni are as follows:

Number of respondents: N = 90

Average age upon graduation: 36

Time span from graduation: 1–12 years

Respondent's age range: 36–48

The group was asked to identify, from the courses taught in all institutions offering programme in this field, those courses they believed were currently useful or could be useful in their job. The alumni had experienced 24 of the classes and were instructed to *not* rate based on their student/faculty experience, but to respond if the subject knowledge was of importance in their current position or possibly in a position they aspired to. The same 0–10 scale was used Alumni response (below) is listed in order of importance. All were rated on a scale of 1–10, with the following receiving an 8–10, rounded to whole numbers. Based on clustering of highest importance, the 8–10 score was considered a 'high value' course. The subjects following are shown with number 1, 'overview of the subject matter', having the most votes and given the highest score. Strategic thinking was given the twentieth most votes given.

1. Overview of the Subject Matter
2. Communications
3. Organisational Behaviour
4. Negotiation
5. Innovation
6. Decision-Making
7. Theory of Product Design
8. Methodology of Product Design
9. Decision Strategies
10. Market Research

11. Marketing
12. Ethics
13. Leadership
14. Capstone development
15. Management Fundamentals
16. Visual Communications (sketching)
17. Research Methods
18. Product Management
19. Project Management
20. Strategic Thinking

4.4 Common Opinions

The review of all three groups represents common agreement for approximately half the coursework listed. The variance, amongst alumni versus academia and industry leaders, indicates lack of consensus with some scores showing variations of 5 versus 9. Problem framing, communications, design futures, cultural difference, supply chain, human factors, industrial design, and methodology show the greatest variant between alumni and leadership in both academia and the corporate environment.

The above noted subjects were rated as ‘5’s by alumni, whilst both academic leaders as well as business leadership believed their importance rating to be 8–10. A preferred view could be granted to industry leadership as they perceived their needs when hiring from these program. The rating scale given was on a scale of 1–10 with 10 being of ‘high importance’.

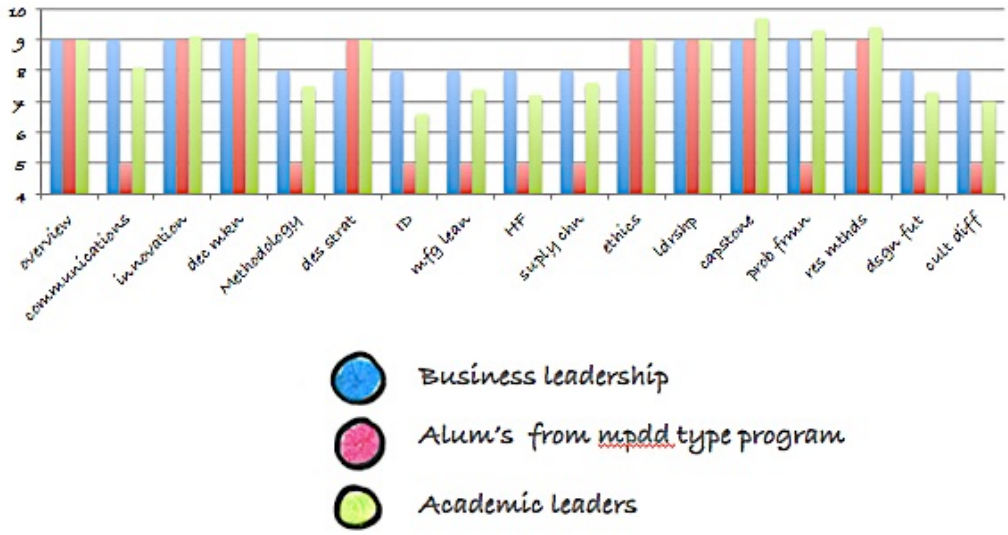


Figure 27: Coursework Valued by Business Leadership Versus Academic Leadership Versus Alumni

Figure 29 is a graphic representation of coursework valued by business leadership versus academic leadership versus alumni from a master of product design and development programme. Referencing the above graphic, the following five courses share the highest value and unanimity amongst the three groups.

1. Overview of the Subject Matter
2. Innovation
3. Decision-Making
4. Leadership
5. Capstone

The next highest group, with unanimity, is as follows.

6. Decision Strategy
7. Ethics
8. Research Methods

4.5 Academic Importance Versus Academic Teaching

A visual graphic, figure 30 was developed for understanding course work 'importance' by business leadership; alumni from one programme and academic leaders. A second

visual graphic, figure 30, was developed for understanding coursework taught versus coursework cited as important from those in the professions.

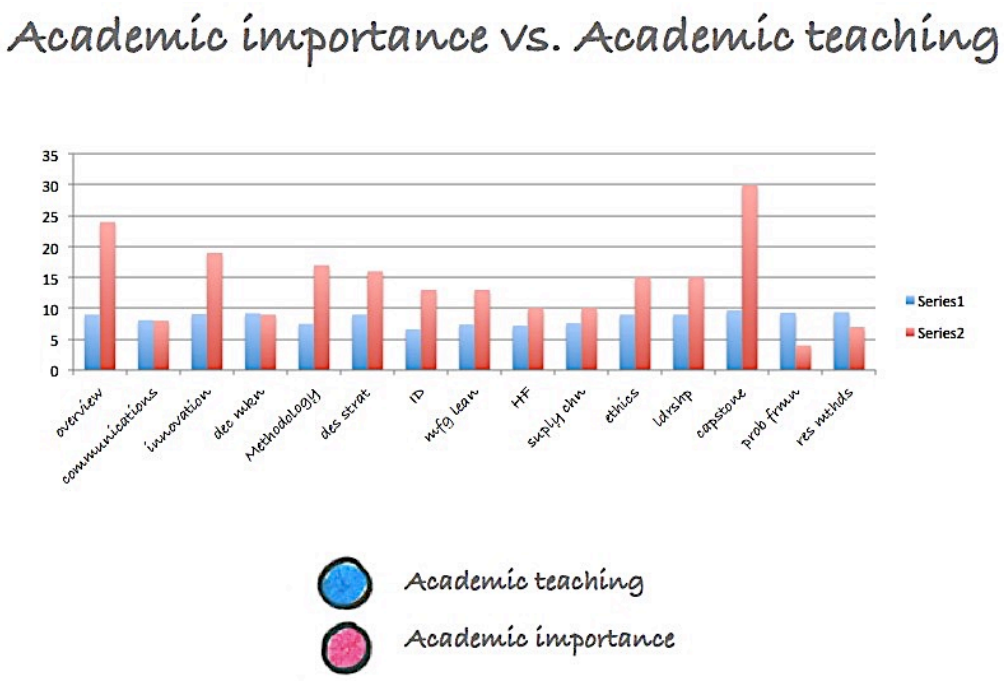


Figure 30: Academic Importance Versus Academic Teaching

Figure 30 relates to the on-going discussion of rigour versus relevance as noted earlier.

> The universities and practitioners belong to different cultures separated by epistemic, organisational and cultural differences. The significance of this argument can be see through the Science Board Innovation Report – Making Industry-University-Partnerships Work (2012) which argues (p7) that the cultural divide between the two domains ran deep and acted as a brake on universities engaging in effective collaboration with business. (Ash 2014)

As noted in figure 30, there is not consistency between what academics in the USA say about how they value specific coursework versus, what according to the programme's literature, as to what they teach. Reasons may be numerous and should be reviewed in post-doctoral efforts. Some teaching is done without believing it to be of importance, as noted by 'problem framing' and 'research methods'. The high number of response of 30 institutions teaching the subject of 'capstone' indicates that 30 of the original 35

institutions in the study believe that such a course is of high value. Noted above, the red line of high value or 'importance' is at '30' whilst the adjacent blue (teaching) line shows a response for actually teaching the subject to be of '9'. Similarly, the 'overview' subject indicates 24 institutions believe it to be of importance, yet only 9 teach that subject.

The researcher's conclusion that what academics believe to be important versus what they teach, may be based on either a lack of background for teaching the specific subjects and/or a lack of importance, by virtue of not having external advisory boards.

4.6 Naming for Master's Degree's

As previously noted, institutions offering degrees in the general area of product design and development number 35, and of those, there are 24 different degrees awarded. Whilst one could make an argument that coursework varies in those programme , it is also shown that MBA coursework varies as well, albeit not to the same degree; however, there is still variety. All graduates of business management programme , of which there are up to 4,000 programmes, have the same 'MBA' title, which is a known entity to those who are in a position of hiring.

The below graphic is symbolic of the numbers of MBA programme and additionally symbolises the naming of all business masters degrees under one brand, MBA, whilst the 'noise' references the disparity of product design and development management programme with their multiple names.

Figure 31: Disparity in the Naming of business programme under one MBA brand, versus multiple design and development management names

Figure 31 is a representation of the disparity of naming of 4,000 MBA programme versus the 24 different names of MPD-type programme .

4.7 Variance, Hypothesis, and Opportunity Questioned

Design-centric industry leaders have initially identified 17 different individual courses they desire their directors of product design and development to have knowledge of. Additionally, they identified seven critical core classes. Those include capstone, introduction to product design and development, innovation, communications, decision-making, leadership, and problem framing.

On the MBA side of the spectrum, within the top ranked 15 institutions, eight core classes are the most often identified. They are finance, operations, marketing, accounting, economics, global economics, organisational behaviour, and leadership. All programme specialising in the management of product design and development

recognise that in spite of various alternatives they teach, basic MBA classes are hypothesised as a critical component of these programme . MBA programme and those desired by design-centric leaders need to be further reviewed for optimisation. As noted in the following graphic, only 'leadership' as represented on the MBA highest taught classes, and alternately desired by design development corporate leadership in their opinions is common.

Figure 28: The most popular MBA courses versus PD&D management courses most desired by leadership

Figure 32 is a graphic representation of the most popular classes taught in MBA programme and those classes thought most important by design-centric leaders in industry for managers of product design and development. Whilst the above references the seven *highest* rated courses by design-centric leadership, the following 13 courses thought to be beneficial by leaders for those involved in the management of product design and development.

Introduction to PD&D
Communications
Organisational Behaviour
Innovation
Decision-Making
Design Strategy

Lean Manufacturing
Supply Chain
Leadership
Capstone
Problem Framing
Research Methods
Design Futures/Empathy

The research question prior to starting this project was that design-centric leaders' opinions, relative to the hiring of managers, would have high regard for management type classes as taught in MBA programme . That question is interpreted by the following graphic, indicating some combination of design and development classes with some combination of MBA classes. The combination, it was thought by the researcher , would lead to the optimum coursework that might be most advantageous for the hiring of leaders.

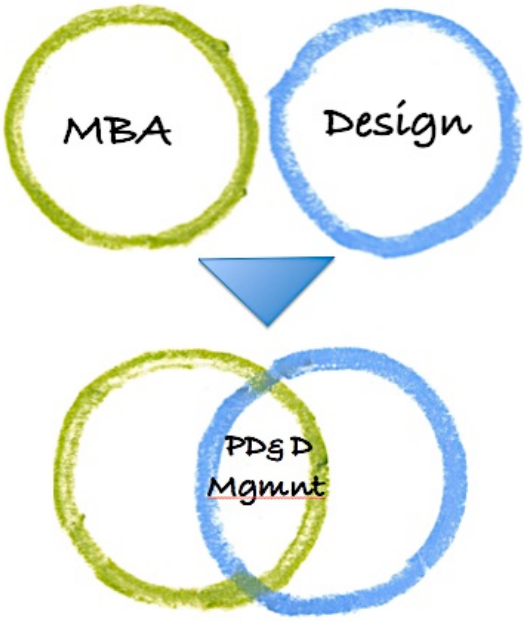


Figure 29. MBA and Product Design Teaching Overlap

Figure 33 is a representation of both MBA teachings and Product Design and Development teaching, finding some combination whereas an overlap could lead to an optimum curriculum.

4.8 Chapter Summary

The 'results', chapter 4, based on the opinions of industry leaders, academic leaders, and alumni from one of the programme, does not reflect the preconceived thought of the researcher of a potential blending of an MBA type and advanced design development programe but does represent a strong opinion as to the coursework deemed most beneficial for management of product design and development. The chapter reviews the 35 worldwide institutions and their coursework for the degree that encompasses work for master's of product design and development management degrees. The coursework questionnaire was limited to 56 courses that are included in a minimum of two programmes.

Coursework that includes overview of the subject, innovation, decision-making, design strategy, ethics, leadership, capstone, problem framing, and research methods were chosen as 'important' to 'most important' by all three groups queried. Based on the hypothesis that some combination of business courses would be included in the opinions of those queried, a separate study of commonality of MBA courses was included. The MBA courses did have a more of a common basis of curriculum, with commonality that included 15 of the top rated schools having five courses shared by at least 14 of the schools.

In addition, the chapter reviews the naming of the degrees. Of the 35 institutions reviewed, 32 separate naming's are shown with very little commonality. Commonality is limited to only two names used by three institutions each. The next most common name includes two sets of two intuitions using the same name.

Chapter 5: Research

5.1 Introduction

The chapter is introduced with an overview of the findings based on rankings from academics and rankings from industry. A discussion follows referring to the reasoning behind, and the support of the 0–10 scale, with descriptive anchors on both ends, used in the questionnaires. This scale is applied, recognizing it is subjective, and based on the lived experience, and from the researcher's perspective, the intervals are equal as would be in any interval scale. There is no intent to suggest this is a positivist science based study, but rather used to offer insight and a deeper understanding of this context.

Core subjects for teaching product design and development management are clarified through two different questionnaires to industry leaders culminating in a ranking, whilst core subjects are also clarified and confirmed through a questionnaire to academics based on their opinions as well as alumni from one programme.

5.2 Introduction to Findings / Explanation of Scale Used

Industry leaders, academic leaders, and alumni from one programme were introduced to the courses taught in programme offering degrees in product design and/or development or some derivation of that name. All were asked to rank those courses based on their opinion as to the importance of each of the courses. Rankings were based on a range of 0–10, which the researcher has defined as an interval scale, whereas the difference between any two values is evenly spaced.

A questionnaire as a basic research tool was employed asking for opinions, in a numeric format, to values of courses offered. The questionnaire has a familiar format and is quick to complete (Curedale 2013: 213). The method of using 0–10 is based on 'likelihood' and is referenced by Bradburn, Sudman, and Wansink (2004: 131). According to Bradburn, *et al.*, this method is especially valuable for researchers. The likelihood of the questions having a high level of discrimination is also noted. The eleven-point allows for any 'middle of the road' indifferent respondent, as 'respondents should not be forced to express their views' (Bradburn *et al*., 2004: 142).

In support of the researchers reason for choosing this 0 – 10 scale, Cummins *et al* (2010) refer to Decile scales with levels from 0-10, corresponding to different levels of 'strength'. They make the claim that the 0–10 scale is the most intuitive and easiest to comprehend and conceptualize. They refer to concepts and children counting tasks on their fingers and toes. The authors argue that since many people have a capacity to discriminate beyond seven points, restricting them results in loss of more discriminate data points. The authors conclude their paper by suggesting scale sensitivity is a critical concern and small deviations are highly meaningful; as such, they propose the number of choice options needs to be expanded beyond a standard five- to seven-point Likert scale. They also espouse the "naming of the points is quite unnecessary and actually detracts from the interval nature of the scale". Their solution is to adopt a scale that lies within common experience and allows greater sensitivity.

Based on the above, the researcher's desire was to assure a more authentic evaluation of values, as perceived by those responding to the questionnaire. Thus it followed that by using the 0 – 10 scale, the finer delineation would lead to more accurate value.

It should be noted that according to Munshi (2014), Likert, in his original paper, did not consider the number of choices to be an important issue. The number '5' usually associated with Likert scales most likely came about from Likert's own writing, according to Munshi, in that if five alternatives are used, three should be assigned to being undecided. The suggestion, according to Munshi, is that the number of choices should be left to the researcher. Munshi (2014: 1) goes on to state, "in practice researchers often do assign the number of choices arbitrarily according to personal taste or past convention". The earliest work in scales suggests that finer scales have a higher reliability than coarser scales (Munshi 2014).

In order to anchor the scale the researcher named the end points as follows; 'strongly disagree' to 'strongly agree'. A typical Likert scale would be labelled according to the level of agreement as follows: 1 = strongly disagree (SD), 2 = disagree (D), 3 = neither disagree nor agree (NN), 4 = agree (A), and 5 = strongly agree (Qing Li 2013). Munshi's work proposes a different approach that is referenced as a 'novel fuzzy' Likert scale to counter the 'drawbacks' in the standard Likert scale. A point is made that there is information lost as respondents are forced 'to make a choice from the given options that may not match their exact response' (ibid). The solution as developed is one of increasing the scale points to approximate a continuous measure ranging from 0–10.

Russell and Bobko (1992) refer to a number of experiments modelling relationships by using a five-point Likert scale, and allowing half of the users to place a mark on any place on a graphic line whilst requiring half to mark on one of the five points. As they note, the 'information loss … is not surprising' for those marking using only the five point scale. One can quickly visualise the above 5 point scale, with markings allowed any place on the scale, with the result of greater accuracy by virtue of additional values.

According to Brace (2008: 63), "Many of the scales used in measuring …brand perceptions…are interval scales". 'Brand' is noted as being comparable to course 'naming'.. Brace also states the interval scale is widely used in questionnaires, as they are a straightforward way of asking attitudinal questions (Brace 2008). According to Brace (2008: 64), "The ten-point scale is better than the five-point scale, as consumers are more used to scoring on a ten-point scale and are able to cope better than was the case 20 years ago".

The researcher's work begins with the end of a scale described as '0' being of little value, whilst '10' would be high value.

Matell and Jacoby (1972: 657) reviewed the subject of Likert scales, querying an 'optimal number of alternatives for Likert scale items'. They reference multiple writers (Ghiselli and Brown 1948, Garner and Hake 1951, Guilford 1954, and Komorita and Graham 1965) and come to the conclusion that '…too few rating categories… is obviously coarse… we lose much of the discriminative powers of which the raters are capable' (Matell and Jacoby 1972: 667).

Garner (1960: 344) discusses a "consistent rise in information …as the number of ratings categories is increased". Garner (1960: 347) further notes that "an increase in the number of categories increases information…even up to 20". He continues, "there can be no single number of rating categories appropriate to all rating situations" (Garner 1960: 350) and concludes by stating, "Therefore, it is better to err on the side of having too many categories than to err by having too few" (p. 352).

The eleven-point scale was chosen, noting that midpoints are typically chosen, but not always (Azzara 2008). Azzara goes on to note, 'while seven-point Likert scales improve on the traditional five-point sale…there are cases where this scale does not go far enough. The (better) solution was…a scale to allow for decimal answers between each integer' (Azzara 2008: 111). The additional choices, according to Azzara (2008: 111), are especially successful when reviewing products and in the descriptors of individual class courses. The researcher views course descriptions as products and believes the arguments for a larger than standard Likert are supported for this work.

Efficiency of research also comes into view and reference is made to Wittink and Bayer (2003: 20) who favour the ten-point scale, as it offers 'only 71.3% of the sample size required for the 5-point scale'. They note that if samples sizes are the same, the ten-point scale affords a higher degree of precision than the standard five-point Likert scale. Additionally, they note the greater scale allows for greater opportunity to detect changes. They make the point that 'it is quite likely that most respondents scoring the firm "5" on the 5-point sale, score it either 9 or 10 on the 10-point scale' (ibid: 20); thus, the larger sample becomes advantaged for accuracy.

Whilst the above comments are not unto themselves, exhaustive, the case for using the 0 – 10 point scale is made. When using the above 0 – 10 scale, areas of consensus amongst educators and corporate leaders became apparent. This section reviews those areas of interest from industry leaders, specifically based on their position of authority for the hiring for managers of product design and development positions.

5.3 Evaluation of Initial Interview and Commentaries from Corporate Leaders

Two separate surveys, were conducted amongst industry leaders from design-centric organisations, as identified in Chapter 3. The organisations selected included a variety of industries and geographic locations. The first survey included 56 course topics. The survey topics chosen were based on more than one institution offering the coursework. Interviewees were informed the specific naming of the courses they would review might not be the same name they use.

The survey was electronically e-mailed prior to the researcher's telephone interviews, in order to assure the interviewee had time to reflect on the subject matter. Numeric responses based on the 0 – 10 scale were requested for the follow up telephone interview. By alerting all recipients the follow up to the e-mail form would be a telephone call, the researcher believed it would result in a higher level of response. That proved to be correct in that there was a 100% response.

The researcher noted the numeric response, which was recorded to ensure accuracy. The method of recording was based on the researcher's telephone being in 'speaker' mode, in concert with a simple digital recording device, allowing transcription at a later date.

The survey referenced coursework found on the sites of programmes offering a masters degree in a programme of product design and development or innovation management (see Appendix A). The purpose of the telephone interview was to assure capture of the scoring in addition to capturing any comments from the respondents. Additional comments were made from 5 of the 20 interviewees and are generalised as follows.

The subject of empathy was of interest to some of the participants and was noted without the interviewer probing the subject. Subject #1 noted, 'Move into the softer skills—ability to communicate, a sense of empathy, is someone's total value based on right or wrong, or not always right but willing to listen and learn?'. Subject #2 noted, '…human to human part. Empathic piece of connecting functional features with emotional benefit…Empathy and delivery delight and happiness is often forgotten…the magic of science and empathy where we connect the functional features of technology with the emotional benefits we want to deliver'.

Aesthetics was also considered a subject that should be reviewed. Subject #2 stated that 'understanding elements of design in multiple fields, and aesthetics as they relate culturally' was of interest. Aesthetics is interpreted to be in the same vein, as the Oxford English dictionary as; 'giving or designed to give pleasure through beauty' Subject #3 stated, '…Need aesthetics—in the broadest sense—colour and shape and even beyond…harmony'.

An appreciation of risk and business design and management issues to include strategy outside of 'design' was of interest. Subject #5 noted; 'can't just be focused on

product—the ability to design business and innovate new business models is incredibly important. Break the mind-set that it's just about the product'. Subject #8 continued on the subject of risk and business by stating that 'risk and opportunity management, strategic thinking as it ties back to decision making…' should be taught. Decision-making, strategy, and business analysis were also noted as additional efforts that need to be taught in those fields.

For this first of two questionnaires, 56 course topics were reviewed by industry leaders. Of those 56, the following 11 courses were given a rating of 8 or higher, based on a scale of 0–10.

Courses	rating
Introduction to Product Design & Development	9.4
Communication	9.1
Problem Framing	9.1
Leadership	8.9
Decision-Making	8.8
Innovation	8.7
Strategic Thinking	8.7
Design Strategy	8.4
Capstone	8.3
Research Methods	8.1
Project Management	8.1

The averages are shown with a one point decimal for accuracy, as rounding to full numbers would result in an 8.6 rounded higher to‘9’, as would a ‘9.4’, rounded lower to the same ‘9’. The 11 selected courses were being taught by one or more of all institutions offering a master’s degree in the general subject of product design and development.

5.4 Final Review Questions for Industry Leaders of Core Subjects

The initial survey demonstrated the potential of 11 subjects as core topics for managerial leadership in design and development, as chosen by industry leaders in the USA. A second survey, performed six months later, of the 11 academic courses noted above, was undertaken to perform a form of validity. According to Golafshani (1947: 559), reliability and validity ‘reveal two strands: firstly with regards to reliability, whether the result is replicable.. Secondly with regards to validity, whether the means of measurements are accurate’. According to Golafshani (1947), when researchers speak of research validity and reliability, they are usually referring to research that is credible, as it depends on the ability and efforts of the researcher. LoBiondo-Wood and Haber also note reliability and validity in qualitative research are not viewed separately, as that “terminology encompasses both and includes credibility and trustworthiness” (2014: 219). Reference is made that in any qualitative research, the aim is to probe for deeper understanding rather than just probing the surface.

Having noted the above, this second study can be termed to be a form of face validity. Validity has multiple meanings according to Golafshani (1947) and ‘face’ may also require clarification as follows:

(1) Validity by assumption

(2) Validity by definition

(3) The appearance as well as the reality of validity (191)

'Face validity' is a test assumed to be valid if the items addressed 'appear on their face…to have a common-sense relationship to their objective' (ibid: 192).

By Golafshani's definition, the "validity by definition…has a population of questions from which the sample comprising the test was drawn" (1947: 192). The appearance of validity should appear valid. The usage assumes face validity is simply a test, not a validation that the test should appear practical and pertinent and related to the purpose. In reviewing qualitative research, with interview methods Patton (2001) notes "the researcher is the instrument" (Patton 2001: 14). Patton, in describing his pragmatic and concrete approach, states the following:

> "We identified relevant questions, conducted interviews and observations, and kept the analysis straightforward as possible, focused on generating useful and understanding data for program improvement. It seemed to me that one could engage in straightforward qualitative inquiry of this kind without locating it with some major philosophical ontological, epistemology tradition." (Patton 2001: 263)

Patton suggests that a variety of methodological approaches are needed and the challenge is not adhering to some "narrow methodical orthodoxy" (2001: 264). It is this very approach that is used for the survey undertaken. The value of Patton's work is appreciated by this researcher who is not defining any specific approach. This study is aimed to ask relevant questions in order to gain useful knowledge, that could help shape and develop future course work. If one first has to analyse what reference of research methodology has to first be asked, the value of the work could be minimised.

The second survey represented the 11 core topics that emerged as the highest-rated for the study of management of product design and development. The survey was sent to the original expert panel and included an additional six experts to review and rank each course separately in terms of perceived value for the role of manager in this field. The popular name and secondary name of the basic subject, if needed, were included, as was a brief description of the subject matter. The leaders were asked to rank each academic course with a value range of 0–10. The 0–10 range expressed their opinions as to expectations for management skills for a product design and development role. The 0–10 scale was chosen to assure greater accuracy as noted above. They were specifically asked for their final opinion 'as to how closely these 11 topics match your own expectations for leadership of PD&D'. They were instructed to indicate the extent to which they agreed on a scale of 0–10, with the value with '0' noting a strong disagreement and '10' a strong agreement.

Table 5: Survey Table

Popular Name	**Secondary**	**Description**
Intro to Product Design & Development	Foundation; Intro to Product Design	Overview of the process of design development.
Decision-Making		Probabilistic concepts, modeling and methods for analysing decisions.
Design Strategy	Branding	Understanding culture of innovation, collaboration, design language, user empathy, ethnography.
Leadership		Building trust, credibility and respect; working with teams.
Ethics	Regulations	Understanding core values, ethics at the heart of leadership, understanding government regulations.
Capstone	Thesis / Major project	Coursework consisting of identifying an opportunity, designing, engineering, manufacturing, costing and understanding supply chain, to include financial. modeling
Innovation	Creativity	Thinking out of the box, tools for creativity and innovation, brain storming.

Research methods		Various methods for understanding and collecting data.
Problem framing		Interpreting events to allow for focus.
Project Management		Meeting project objectives with processes, methods, and knowledge.
Strategic		Cognitive process by an individual for achieving success.

This second survey was sent approximately 6 months after the original survey that included 56 courses from all institutions. The eleven courses noted above were based on those courses that were ranked amongst the most valued in the opinions of industry leadership.

5.5 Final Overall Ratings of Leaders

The second questionnaire response came from 16 of the original 20 leaders, or 80%, and all six of the additional experts. For this user-centred approach, Creswell (2009: 64) indicates that the number of five to 25 participants is appropriate. Morse (1994: 225) notes that at least six participants are appropriate for phenomenology studies. Thus the 16 original responses plus the additional 6 are considered appropriate for this study.

This approach, as described by Creswell (2009: 13), is both a philosophy and a method wherein the researcher allows for the essence of human experience and 'understanding the lived experiences' about a phenomenon, using a 'small number of subjects…to develop patterns'. The significance to this study of this purposive sampling, which is dependent on this specific group of knowledgeable experts, is to ensure these industry leader opinions, regarding their needs, is brought to bear.

The identical scale used for the first round of voting was used for the second round and ranged from '0', representing strongly disagree, to '10', strongly agree, as to the value of the subject for management of product design and development management. The identical 11 courses initially chosen as those most important were then rated as follows.

Introduction to Product Design & Development	8.4
Decision-Making	7.4
Design Strategy	8.4
Leadership	8.9
Capstone	8.2
Innovation	8.2
Research Methods	7.5
Problem Framing	9.1
Communication	8.5
Strategic Thinking	8.5
Project Management	7.8

The results show that 3 of the original 11 did not achieve a score of 8, or above, which was the original value used to determine the courses that would move to the second round of review. 'Problem Framing' achieved a rating 9.1 whilst the lowest 'Decision Making' received a 7.4, for a 19% difference. The researchers' aim is to identify those courses that in the opinion of leadership are most relevant, thus this second round of review

5.5.1 Ratings with the high and low removed

As there could be outliers, as noted by Oxford English dictionary as a data point larger or smaller than the next nearest, the outliers were removed to reduce the skewing of results. Only one 'highest' and only one 'lowest' grade were removed. Resulting scores are as follows:

Problem Framing	9.2
Leadership	8.9
Strategic Thinking	8.6
Design Strategy	8.5
Communication	8.5
Introduction to Product Design & Development	8.4
Capstone	8.4
Innovation	8.2
Decision-Making	7.8
Project Management	7.8
Research Methods	7.4

5.6 The Core Curriculum

The original data collected from 35 institutions, offering a masters degree in the general subject of product design and development recognised 60 separate courses offered. A review of those courses with industry leaders allowed for a listing of the top 11.
Based on a secondary review six months following the initial review, the following eight received the highest rankings and are the recommended courses suggested for 'core' for

the master's degree programme specialising in product design and development management.

Table 6. Recommended Courses

Popular Name	**Description**
Introduction to Product Design & Development	Overview of the process of design development.
Design Strategy	Understanding culture of innovation, collaboration, design language, user empathy, ethnography.
Leadership	Building trust, credibility and respect; working with teams.
Capstone	Coursework consisting of identifying an opportunity, designing, engineering, manufacturing, costing and understanding supply chain, to include financial modeling.
Innovation	Thinking out of the box, tools for creativity and innovation, brain storming.
Problem Framing	Methods of gathering information, to include qualitative and/or quantitative studies. Subdivided into focus groups, interviews, literature searches, etc.
Communications	Oral and written communication to include reports, presentations.
Strategic Thinking	Mental process to arrive at decisions for achieving success relative to work or personal life.

5.7 Conclusion

This chapter began with a discussion of the 0–10 scale used in the questionnaires, based on research supporting this scale, versus a smaller 5–7 point scale, typically known as a Likert scale. This alternate point of view is based on the greater range, leading to what Wittink and Bayer (2003), amongst others believe, which is that the greater scale has greater accuracy and offers a higher degree of precision on a relative basis than the five-point scale. It is precisely for this reason the researcher selected the scale used.

Two different questionnaires with industry leaders were reviewed. The initial review of 52 different courses taught in more than one product design and development management programme was based on subjects being taught in more than one institution within a product design and development management curriculum. The initial survey culminated in a core class recommendation of 11 different courses that received a rating of 8 or above. A second review six months later revealed eight classes as dominant. These eight classes consisted of the following:

- Introduction to Product Design and Development
- Design Strategy
- Leadership
- Capstone
- Innovation
- Problem Framing
- Communications
- Strategic Thinking

Based on the opinions of industry leaders responding to the question of what coursework they considered to be most important for the individual leading their product design and development management team, the above eight classes should be considered as ‘core’ classes for these programmes.

Chapter 6: Conclusion—Aims and Objectives

6.1 Introduction

The aim of the research was to first identify those institutions worldwide that offer degrees in the general subject of product design and development management and to identify and capture all coursework taught in the above programs to further include and identify the names of the degree award from those programs. The objective was to be the development of a core curriculum based on the opinions of industry leaders within the USA in order to assure compliance with the needs of those in hiring position. An additional objective was to identify those courses believed most important by alumni of one programme.

The chapter identifies the numbers of programmes taught worldwide in the subject of product design and/or development or innovation management, as well as the individual courses taught, and includes the individual names of the programmes. It continues with a description of the contribution to knowledge brought forth by referencing the initial aims, and concludes with the objective of defining a core curriculum based on the opinions of USA-centric leadership responsible for the hiring of management for this area of interest. The chapter continues by reflecting on this new data and the ramifications beyond simple listing of course work. This chapter concludes by recognising the limitations of the objectives and suggests future work that could be completed by others.

6.2 Overview

Design development management type programmes are becoming more popular, based on the trend that there were no programmes within the USA in the year 2000, and today there are 17. The subject is relatively new, and an increase in demand is allowing for the growth—thus the recognition to bring new understanding to the field by exploring uniformity in student learnings, or student acquisition of knowledge. Worldwide, there are 35 such programmes offering a master's degree in the general subject of product design and development management. Sixty courses are taught within those 35 institutions. Not only is there widespread content, as shown by the 60 different courses taught, but the 35 institutions do not share a common name in the same manner as those studying business at a master's level for business administration who share the name of 'MBA', or Master of Business Administration. Rather, the 35 institutions have 32 different names of their degrees. Six institutions share two of the most popular names whilst another four institutions share another two names. All remaining 28 institutions have names not repeated by others.

6.3 Contribution to Knowledge Referencing Initial Aims and Objectives

Five initial aims and objectives were presented in an effort to bring clarity to the field of product design and development management as taught worldwide. They were noted as follows:

Aims:

- Identify those institutions worldwide that offer degrees in the general subject of product design and development management.

- Capture all coursework taught in the above programs.
- Identify the names of the degrees awarded from the above programs.
- Identify from alumni of one program that offers the above degree, those courses available from all schools that those alumni believe to be most important.

Objective:

- Identify the core programs that those in academia and industry leadership believe to be most important.

Contribution to knowledge is as follows:

1. Identify those institutions worldwide that offer degrees in the general subject of product design and development management.

Thirty-eight institutions have been identified, from 3 regions of the world.

UK institutions:

Aston University
Birmingham City University
Bournemouth University
Brunel University London
Cardiff School of Art and Design
Lancaster University
University of Glasgow
University of Liverpool
University of Warwick

European and Scandinavian Institutions:

Barcelona School of Design & Engineering
Chalmers University of Technology
IED Barcelona
University of Applied Sciences / Upper Austria
International Hellenic University
Technische Universiteit Eindhoven

North American Institutions:

California College of the Arts
Carnegie Mellon University
Cranfield University
Institute of Design IIT
Kendall College of Art & Design of Ferris State University
San Francisco State University
Maryland Institute College of Art
Parsons The New School of Design
Philadelphia University
Pratt Institute
Rochester Institute Technology
University of Pennsylvania
Milwaukee School of Engineering

Massachusetts Institute of Technology
Northwestern University
University of Detroit Mercy
Virgina Commonwealth University da Vinci Center
Schulich School of Business (York University)
Savannah College of Art & Design
University of Pennsylvania

The area of pedagogy for product design and development management, while active in the UK, Europe and Scandinavia, as well as North America does not as yet have any activity in Asia, South America or Austral Asia. Reference could be made to the work of Edquist and Hommen (2008) in which they study a wide range of national contexts on innovation, in 4 continents (north and South America, Europe and Asia). The study includes large and small countries and with various levels of economic development. "Although …countries are similar on many dimensions (size, economic performance, diffusion of ICT [information communication technology], etc.), they are very different in many other respects" (ibid; 30). Edquist and Hommen suggest in their writing that an entire book needs to be written as a much deeper analysis is "necessary and possible" (ibid; 16) on the various areas of NSI (national system of innovation).

2. Identify all coursework taught in the above programmes.

Sixty discrete courses have been identified as emanating from 3 different colleges and/or programs to include: Business; Design and Engineering. Of the sixty discrete courses, 56 appear in more than one programme. Business based courses account for 28 of the 56, design based course work account for 16 of the 56 and engineering based course work account for 12 of the 56.

The take-a-way, from the above, is the recognition that in spite of a lack of consensus, half of the course work offered is business based. The opinions of industry leadership

agrees in principle, that half of the core classes for the teaching of the management of product design and development should be business based.

3. Identify the names of the degrees awarded from the above programmes.

28 different degree names are awarded from the 35 institutions. The prefixes vary from Master of Science (9); MBA (1); Master (5); Master of Professional Studies (1); Master of Arts (1).

Descriptions of the naming of the degrees include any combination of the following words; Product; Development; Integrated; Design; Management; Innovation; Strategy; Services; Leadership; MBA; International; Industrial; Arts; MFA; Engineering. A complete listing of degree names is included in Appendix C.

The lack of a single, or even a greater commonality of names, could be linked to the diversity of and lack of common core course work. It might be expected that if a common core of course work could be achieved, the naming of the programme could take the similar path that business schools took with their common core. An example would include the #5 ranked (US News and World Report, 2017) Northwestern University's Kellogg Graduate School which maintained its' original degree name of Master of Management (MM) and changed to Master of Business Administration (MBA) in 2000.

4. Identify, from 90 alumni of one programme that offers the above degree, those courses available from all schools that those alumni believe to be most important.

The following are ranked as the top 20:

Overview of the Subject Matter
Organisational Behaviour
Innovation
Theory of Product Design
Decision Strategies
Marketing
Leadership
Management Fundamentals
Visual Communications (sketching)
Project Management
Communications
Negotiation
Decision-Making
Methodology of Product Design
Market Research
Ethics
Capstone development
Research Methods
Product Management
Strategic Thinking

Whilst only 6 of the 8 highest scored courses from industry were listed in the top 20 of the alumni listing, it needs to be recognised the alumni have reached, what is commonly known, as middle management by title. They have not yet achieved the highest level that those in the leadership survey have, thus the perspective is not the same.

5. Identify the core programmes that those in academia and industry leadership believe to be most important.

The core curriculum, in the opinion of 20 top industry leaders from multiple disciplines within the USA, are eight courses of study they consider essential for managers of product design and development departments. They are listed in order of importance. The listing shows the average score amongst the leadership and additionally shows averages after eliminating outliers—with outliers being one score ranked highest and one score ranked lowest.

	Elimination of outliers	Average with outliers
1. Problem Framing	9.2	9.1
2. Leadership	8.9	8.9
3. Strategic Thinking	8.6	8.5
4. Design Strategy	8.5	8.4
5. Communication	8.5	8.5
6. Introduction / Overview	8.4	8.4
7. Capstone	8.4	8.2
8. Innovation	8.2	8.2

The above courses are recommended as the 8 core classes by industry leaders, as the next highest valued course was below '8'. Thus the highest ranked of the above to the lowest is approximately a 9% difference.

6.4 Ramifications

The above 5 aims and objectives were realised allowing for this new data to become the basis for integration of curriculum with-in a USA based curriculum.

The researcher's interest is based on developing standards to allow industry to provide a better return on their investment in design and development, by having graduates that meet basic needs for managing the process. Recognising new products are the top factor for growth, as opposed to other opportunities that include: turnarounds; new channels; joint ventures; and mergers and acquisitions. (Deloitte, 2007: 1) the value of the need for effective management of product design and development for industry is brought

forth by others. Cooper (2011) points out that "some sources cite the failure rate at launch [of new products] to be as high as 90%' (p. 18). Studies of new product revenue relative to gross revenue averages 34% and that 79% of sales are obsolete within 3 years due to changing customer demands and competitive offerings (ibid;18) accentuate the need industry has for properly managing product design and development. Research and development average approximately $600 billion in the USA alone (Cooper: 16) thus, the value of finding better ways to satisfy industry for the management of product design and development becomes more meaningful.

6.4

6.5 Insight - Conflict of classes taught, versus classes desired by leadership

The following subjects were most taught with-in all institutions noted.

Design Management	Introduction to Product Design
Marketing	Market Research
Innovation	Project Management
Theory and Methods of Design	Design Strategy
Finance	Sustainable Development
Capstone	

Only 4 of the core classes deemed to be most important by industry leaders are included in the 11 most numerically popular courses being taught in the USA programmes. As noted earlier, but worth repeating, could include lack of background in teaching these subjects, whilst another reason could be the lack of oversight by an external board of advisors.

Of all 60 subjects taught worldwide, the two programmes most taught in the USA are Introduction to Product Design and Development and the Capstone (multidisciplinary) course. Based on industry needs, one could come to a similar conclusion as the researcher, which is that what industry deems to be most important should be included in curriculums for product design and development management.

6.6 Limitations of the Research

The limitations to the research are recognised, as there was no prior work in this area of study for reference. As such, there is no library of copious published work as a foundation on which to build. Thus the research was limited to reviewing online and print versions of all programme offerings from those institutions with degree programmes and coursework in product design and development management. Additionally, there were limited journals dedicated to the subject, including a publication by the Design Management Institute. However, there was no degree of specificity that would allow a building upon prior writings specific for this area of interest.

In an effort to generate a boundary that would allow the gaining of information from industry and academic leaders, as well as alumni from one programme, questionnaires and interviews were limited to restricting that part of the study to the USA. An additional limit was relying on published online data from university websites describing the content of their courses and interpreting, where necessary, the naming of the courses.

The expertise of this researcher, based on years of experience both in academia as well as in the field, has allowed for insights from known experts in leadership, all of whom have been involved in worldwide operations and allows for recommendations for future practice.

This study aimed to understand the global teachings and to further establish the needs of USA-centric corporate leadership wants for managers in product design and development. Further work may include detailed standards and perhaps a method for influencing the teaching, first within the USA and then globally. Additional efforts could also include the common naming of the degree and codification to allow leaders the same sense of specialty value they will receive, as they now perceive from those with an MBA degree. The study has been done in as rigourous a manner as possible based on the above constraints but should be viewed as a basis for continued work leading to greater standards.

6.7 Future Work

Whilst the final evaluation is restricted to the USA, several aspects could be extended in the future by exploring the international offerings. That work could be developed by the present researchers or by others. The international work may well uncover cultural differences. Additional efforts can also include a deeper understanding of actual curriculum taught versus curriculum as described on the individual websites. It is recognised that the methodology used for contribution to knowledge gained for this

specific field might have applications in other professionals' fields with further development of the methodologies.

The findings will be initially shared with USA educational leaders through journal publications and conference presentations. Additional efforts will continue with industry leaders, with the aim of identifying appropriate naming for the degree. Industry leaders versus academic leaders appear to be in the best position, as they hold no bias to any specific programmes to recommend the proper naming of these programmes.

Additional efforts should include greater depth in the international arena, with research concentrating on country-specific needs for design and development management. Country-specific is noted, as cultural differences, and may be a component of individual core subject matter taught. Inasmuch as Great Britain has the second-largest number of institutions teaching in this area, with 10, it is recommended that the next step in this work be done there.

6.5 Summary

In this chapter, the aims and objectives of the study were reviewed. It concludes the contribution to knowledge with the naming of the eight core subjects that, in the opinion of industry leadership, are as follows: Introduction to Product Design and Development; Design Strategy; Leadership; Capstone; Innovation; Problem Framing; Communications; and Strategic Thinking. Confirmation of those 8 are also noted to be most important to the field by academics, however the course work is not taught by them. The alumni are

included in a triangulation, in that 6 of those highest cited are include as most important by the alumni. It is also noted that the alumni have not as yet achieved the same level of seniority as the industry leaders included in the survey. Included in the chapter is the identification of all 35 institutions, and they only reside within 3 areas of the world. Those include: UK; European and Scandinavian as well as North American. Reviews of all names of the masters degrees and all descriptors that in multiple combinations contribute to the naming of the 28 different degrees awarded, offer insight into the disparity and range of courses resulting in the variation of naming. Noted are the core subjects of business, engineering and design that make up the 60 courses offered, with business course offerings half of all courses by all institutions attesting to their value.

Ramifications were reviewed bringing to light the cost of developing products in a world market and the failure rates in bringing products to market.

The thesis question: “Can current design and development management pedagogy respond better in reflecting industry needs?” is answered by the triangulation revealed in the industry questionnaire regarding most valued subject, supported by academia irrespective of actual courses taught, and by alumni of one program. Greater academic robustness based on professional practice will be relevance to what is currently a disparate array of programming, resulting in market place confusion as to knowledge.

The new knowledge brought forth to this subject should allow for a more structured and dedicated development within institutions, thus assuring their audience of industry leaders the support required for leadership of product design and development.

References

Academy of Marketing (2014) *Conference History* [online] available from <https://www.academyofmarketing.org/conference-history/conference-history> [8 October 2014]

Academy of Management Journal – In Press

Adkins, C. P. (2009) Is Empathy the Missing Link in Teaching Business Ethics? A Course-Based Educational Intervention with Undergraduate Business Students. PhD thesis [online]. Williamsburg, VA: The College of William and Mary, available from <http://gradworks.umi.com/33/57/3357528.html> [4 September 2016]

All Business Schools (n.d.) [online] available from <http://www.allbusinessschools.com/business- careers/article/business-school> [12 October 2014]

American Institute of Architects (AIA) (2016) *Exhibitor Prospectus* [cached online] available from <http://convention.aia.org/Assets/Content/doc/AIA_Expo_2016_Exhibitor_Prospectus.pdf> [5 August 2014]

American Institute of Physics (AIP) (2016, 25 February) 'House Science Committee Unveils Agenda and Priorities for 2016' *FYI: The AIP Bulletin of Science Policy News* [online] (24). available from <https://www.aip.org/fyi/2016/house-science-committee-unveils-agenda-and-priorities-2016> [3 August 2016]

Annacchino, M. A. (2007, November) 'The Pursuit of New Product Development: The Business Development Process' *Journal of Product Innovation Management* [online] 25 (1): 108–110. doi: 10.1111/j.1540-5885.2007.00285_3.x [14 August 2014]

Anon. (2007, 28 August) 'Business Schools and Research: Practically Irrelevant?' *The Economist* [online] available from <http://www.economist.com/node/9707498> [10 February 2016]

Archer, B. (1995) 'The Nature of Research'. *Co-Design: Interdisciplinary Journal of Design* [online] 6–13. available from <http://archive.org/details/TheNatureOfResearch> [4 September 2016]

Ash, M. (2014) Knowledge That Counts: An Examination of the Theory Practice Gap Between Business and Marketing Academics and Business Practitioners Examined in Terms of Their Respective Epistemic Stances. PhD thesis [online]. Derby: University of Derby, available from <http://derby.openrepository.com/derby/bitstream/10545/333867/1/Thesis+submitted+accepted1.pdf> [21 June 2015]

Association of MBAs (AMBA) (n.d.) *What Is Accreditation?* [online] available from <http://www.mbaworld.com/en/Accreditation/What-is-accreditation.aspx> [25 August 2015]

Association to Advance Collegiate Schools of Business (AACSB) (2013). *AACSB Accreditation* [online] available from <http://www.aacsb.edu/accreditation> [18 October 2014]

Augier, M. and March, J. G. (2007) 'The Pursuit of Relevance in Management Education'. *California Management Review* [online] 49: 129–146 available from

<http://cmr.berkeley.edu/search/articleDetail.aspx?article=5446 > [14 August 2014]

Azzara, C. V. (2008) *Questionnaire Design for Business Research: Beyond Linear Thinking—An Interactive Approach*. Mustang, Oklahoma: Tate Publishing

Baillie, C. and Walker, P. (1998, March) 'Fostering Creative Thinking in Student Engineers' *European Journal of Engineering Education* [online] 23 (1): 35 [Accessed 22 September 2015]

Baker, S. and Holt, S. (2004), 'Making Marketers Accountable: A Failure of Marketing Education?' *Marketing Intelligence & Planning* [online] 22 (5), 557–67 available from <http://www.emeraldinsight.com/doi/abs/10.1108/02634500410551932> [14 December 2014]

Baron, S., Richardson, B., Earles, D., and Khogeer, Y. (2011) 'Marketing Academics and Practitioners: Towards Togetherness' *Journal of Customer Behaviour* 10: 291–304 doi: 10.1362/147539211X602522

Bartunek, J. M. (2007) 'Academic-Practitioner Collaboration Need Not Require Joint or Relevant Research' *Academy of Management Journal* 50 (6) 1323–1333 doi: 10.5465/AMJ.2007.28165912

Bartunek, J. M. and Rynes, S. L. (2010) 'The Construction and Contributions of "Implications for Practice"': What's in Them and What Might They Offer?' *Journal of Customer Behaviour* 9: 5–18 doi: 10.5465/AMLE.2010.48661194 [12 February 2015]

Beder, S. (1999, January) 'Beyond Technicalities: Expanding Engineering Thinking' Journal of *Professional Issues in Engineering Education and Practice* 125 (1), 12–18

Bennis, W. and O'Toole, J. (2005) 'How Business Schools Lost Their Way' *Harvard Business Review* [online] available from <https://hbr.org/2005/05/how-business-schools-lost-their-way> [20 August 2015]

Best, K. (2006) *Design Management: Managing Design Strategy, Process and Implementation*. AVA Publishing

BestColleges.com *Highest Research and Development Funding* [online] available from <http://www.bestcolleges.com/features/colleges-with-highest-research-and-development-expenditures/> [30 March 2014]

Between Academic Rigor and Real World Relevance: The Role of Executive Professors'. *The Academy of Management Learning and Education* 7, 99–107.

Beyer, J.M. and Trice, H.M. (1982, December) 'The Utilization Process: A Conceptual Framework and Synthesis of Empirical Findings' *Administrative Science Quarterly* [online] 27 (4), 591–622. available from <https://www.jstor.org/stable/2392533?seq=1#page_scan_tab_contents> [19 March 2016]

Bingham, W.V.D. and Moore, B.V. (1959) *How to Interview* New York, New York: Harper.

Blaikie,N. (2000) *Designing Social Research*, Cambridge: Polity Press

Blenker, P., Dreisler, P. and Kjeldsen, J. (2006). *Entrepreneurship Education: The New Challenge Facing the Universities: A Framework for Understanding and Development of Entrepreneurial University Communities* [working paper online] available from <http://pure.au.dk/portal/files/32345606/2006%C3%A2%E2%82%AC%E2%80%9C02_ENG.pdf> [22 May 2015]

Bloomberg Businessweek (2012, 22 March) 'Full-Time MBA Rankings' *Bloomberg Businessweek* [online] available from <http://www.bloomberg.com/news/articles/2012-03-20/how-we-ranked-the-schools> [4 June 2015]

Brace, I. (2008) *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*. London, UK: Kogan Page

Bradburn, N. M., Sudman, S., and Wansink, B. (2004) *Asking Questions: The Definitive Guide to Questionnaire Design—For Market Research, Political Polls, and Social and Health Questionnaires*. San Francisco, California: John Wiley.

Braet, J. and Verhaert, P. (2007) *The Practice of New products and New Business*. Leuven, Belgium: Acco

Brown, T. (2008) 'Design Thinking' *Harvard Business Review* 86, 84–92

Bruce, G. and Schoenfeld, G. (2006) *Marketers with MBAs: Bridging the Thinking-Doing Divide* [white paper online] available from <http://www.gmac.com/market-intelligence-and-research/research-library/curriculum-insight/marketers-with-mba-bridging-the-thinking-doing-divide.aspx> [2 February 2015]

Bruce, M. and Bessant, J. (2002) *Design in Business: Strategic Innovation through Design*. Edinburg, UK: Pearson Education

Bruce, M., Cooper, R., and Vazquez, D. (1999) 'Effective Design Management for Small Businesses' *Design Studies* [online] 20, 297–315. doi:10.1016/S0142-694X(98)00022-2 [20 April 2014]

Buchanan, R., (1992) 'Wicked Problems in Design Thinking' *Design Issues* [online] 8, 5–21. doi: 10.2307/1511637 [12 April 2014]

Buijs, J. (2008) ‘Action Planning for New Product Development Projects’ *Creativity and Innovation Management* [online] 17 (4), 319–333 doi: 10.1111/j.1467-8691.2008.00494.x [13 November 2014]

Burrell, G. and Morgan, G. (1979) *Sociological Paradigms and Organisational Analysis: Elements of the Sociology of Corporate Life*. Hants, UK: Heinemann Educational Books

Business MBA (n.d.) *MBA Skills and Competencies* [online] available from <http://www.businessmba.org/program/mba-skills-and-competencies> [18 November 2014]

Cagen, J. M. and Vogel, C. M. (2012) *Creating Breakthrough Products: Revealing the Secrets that Drive Global Innovation*. Upper Saddle River, New Jersey: Pearson Education

Cameron, I.T. and Lewin, D.R. (2009) ‘Curricular and Pedagogical Challenges for Enhanced Graduate Attributes in CAPE’. *Computers & Chemical Engineering* [online] 33, 1781–1792. doi:10.1016/j.compchemeng.2009.05.005

Campbell, J. P., Daft, R. L., and Hulin, C. L. (1982) *What to Study: Generating and Developing Research Questions*. Beverly Hills, California: Sage

Champney, H. and Marshall, H. (1939) ‘Optimal Refinement of the Rating Scale’. *Journal of Applied Psychology* 23 (3), 323

Clarke, K. A., and Primo, D. M. (2012, 30 March) ‘Overcoming ‘Physics Envy”’. *The New York Times* [online] available from <http://www.nytimes.com/2012/04/01/opinion/sunday/the-social-sciences-physics-envy.html?_r=0> [4 August 2016]

Clinebell, S. and Clinebell, J. M. (2008) ‘The Tension in Business Education

Constable, G. (1994) 'Managing Product Design: The Next Industrial Revolution. *IEE Review* [online] 40, 79–82. doi:10.1049/ir:19940214 [23 March 2014]

Cooper, R (2011) *'Winning at New Products'*. New York, N.Y; Basic Books; Perseus Books Group

Cooper, R., Junginger, S., and Lockwood, T. (2009) 'Design Thinking and Design Management: A Research and Practice Perspective'. *Design Management Review* [online] 20, 46–55. doi:10.1111/j.1948-7169.2009.00007.x [4 June 2014]

Creswell, J. W. (2009) *Research Design: Qualitative, Quantitative, and Mixed Method Approaches*. Thousand Oaks, California: Sage Publications

Cross, N. (2000) *Engineering Design Methods: Strategies for Product Design*. Hoboken, New Jersey: John Wiley & Sons

Cross, N. (2001) 'Designerly Ways of Knowing: Design Discipline Versus Design Science'. *Design Issues* 17, 49–55

Crozier, K. (2004) 'How Effectively Do Marketing Journals Transfer Useful Learning from Scholars to Practitioners?' *Marketing Intelligence & Planning* 22

Cummings, L. (1990) 'Reflections on Management Education and Development: Drift or Thrust into the 21st Century'. *Academy of Management Review* 15, 694–696

Cummins, R.A. and Gullone, E. (2000). 'Why We Should Not Use 5-point Likert Scales: The Case for Subjective Quality of Life Measurement. Proceedings, Second International Conference on Quality of Life in Cities, 74–93, Singapore: National University of Singapore

Curedale, R. (2013) *Design Research Methods: 150 Ways to Inform Design*. Topanga, California: Design Community College Inc.

Dacko, S. G. (2006) ‘Narrowing the Skills Gap for Marketers of the Future’. *Marketing Intelligence & Planning* [online] 24, 283–295. available from <http://dx.doi.org.turing.library.northwestern.edu/10.1108/02634500610665736> [16 April 2014]

Damasio, A. (2011) *The Quest to Understand Consciousness* [online TED talk] available from <https://www.youtube.com/watch?v=LMrzdk_YnYY> [30 June 2014]

Davis, M. (2008) ‘Why Do We Need Doctoral Study in Design?’ *International Journal of Design* 2, 71–79

Dawes, J. (2008) ‘Do Data Characteristics Change According to the Number of Scale Points Used? An Experiment Using 5-point, 7-point and 10-point scales’ *International Journal of Market Research* [online] 50 (1) [25 August 2016]

Dawson, C. (2009) *Introduction to Research Methods: a Practical Guide for Anyone Undertaking a Research Project*. London, UK: How To Books

De Mozota, B. B. and Kim, B. Y. (2009) ‘Managing Design as a Core Competency: Lessons from Korea’. *Design Management Review* [online] 20, 66–76 doi:10.1111/j.1948-7169.2009.00009.x [14 April 2014]

de Vere, I., Melles, G., and Kapoor, A., (2010) ‘Product Design Engineering: Interdisciplinary Pedagogy Integrating Engineering Science With “Designerly Ways”’. in *Connected 2010*, ‘Second International Conference on Design Education’. held 28 June–1 July 2010 at the University of South Wales. Sydney, Australia: Design Society, 1–5

Dell´Era, C. and Landoni, P. (2010) 'Living Lab: A Methodology Between User-Centered Design and Participatory Design'. *Creativity and Innovation* 23 (2), 137–154

Deloitte Research 'Marketing Innovation' (2005): Research Gate (1)

DeMarrais, K. B. and Lapan, S. D. (2004) *Foundations for Research: Methods of Inquiry in Education and the Social Sciences*. Abingdon-on-Thames, UK: Routledge

Deng, J. Y. (2011) Postgraduate Design Management Education in China : An Investigation into the Transferability of Design Management Knowledge, Curricula, Teaching and Learning Strategies from the UK to China. PhD thesis [online]. Staffordshire: Staffordshire University, available from <http://eprints.staffs.ac.uk/2183/1/Jian%20Ye%20Deng%20Phd.pdf> [20 June 2015]

Dewey, J. (1938) *Experience and Education*. New York, New York: Simon & Schuster

Dexter, L. A. (1970) *Elite and Specialised Interviewing (Handbooks for Research in Political Behaviour)*. Evanston, Illinois: Northwestern University Press

Disney University (n.d.) *Disney University* [online image] available from <http://allroadsleadtodisney.blogspot.com/2013/06/disney-university-course-registration.html> [20 December 2015]

Do, Gross, Neiman, and Zimring (2000) 'Intentions in and Relations Among Design Drawings'. *Design Studies* 5, 483–503

Dossabhoy, N. S. and Berger, P. D. (2002) 'Business School Research: Bridging the Gap Between Producers and Consumers'. *The International Journal of*

Management Science [online] 30, 301–314. doi:10.1016/S0305-0483(02)00031-2 [14 March 2015]

Drucker, P. (2001) 'Taking Stock' [interview by Chapman, C.] in *BizEd*, 12

Dugan, R. E. and Gabriel, K. J. (2013) '"Special Forces" Innovation: How DARPA Attacks Problems'. *Harvard Business Review* 91, 74–89

Dym, C. L. and Little, P. (2003) *Engineering Design: A Project-Based Introduction*. New York, New York: John Wiley & Sons

Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., and Leifer, L. J. (2005) 'Engineering Design Thinking, Teaching, and Learning'. *Journal of Engineering Education* 94, 103–119

Earley, P. C. (1999) 'Creating Value from Scientific Endeavor: Can and Should We Translate Research Results for the Practitioner?' *Impact Analysis: How Research Can Enter Application and Make a Difference*. (L. Larwood and U.E. Gattiker, Editors), 97–104. Mahwah, New Jersey: Lawrence Erlbaum Associates

Edquist, C., Hommen, L. (2008) 'Small Country Innovation Systems' *Globalization, Change and Policy in Asia and Europe.* Edward Elgar Publishing Limited, Glensanda House, Montpellier Parade, Cheltenham, Glos GL50 1 UA UK

,Frecka, T.J., Hopwood, W.S. (1983) 'The Effects of Outliers on the Cross-Sectional Distributional Properties of Financial Ratios.' *The Accounting Review January* 83*,* 115 - 128

Engineering Counsel (1997) *Standards and Routes to Registration*. London, UK: Engineering Counsel

European Foundation for Management Development (EFMD) (n.d.) *EQUIS Quality Improvement System* [online] available from <https://www.efmd.org/accreditation-main/equis> [23 May 2014]

Evans, B. (1985) 'Japanese-Style Management, Product Design and Corporate Strategy'. *Design Studies* [online] 6 (1), 25–33. doi:10.1016/0142-694X(85)90038-9 [24 November 2014]

Fagenson-Eland, E. A. (1999) 'Thinking Outside the Box: A Commentary on Lynn Luckow's Chapter'. *Impact Analysis: How Research Can Enter Application and Make a Difference*. (L. Larwood and U. E. Gattiker, Editors), 115–121. Mahwah, New Jersey: Lawrence Erlbaum Associates

Financial Times (2013) 'Global MBA Rankings 2013'. *Financial Times* [online] available from <http://rankings.ft.com/businessschoolrankings/global-mba-ranking-2013> [4 April 2014]

Find MBA (n.d.) MBA Program in Europe [online] available at <http://find-mba.com/schools/europe> [22 January 2015]

Formossa, K. and Kroeter, S. (2002) 'Toward Design Literacy in American Management: A Strategy for MBA Programme'. *Design Management Journal* 13 (2)

Freeze, K. J. and Chung, K., 2008. Design Strategy at Samsung Electronics: Becoming a Top-Tier Company. Case study, Design Management Institute, 441

Fowler, Jr, F. J. (2013) *Survey Research Methods*. Thousand Oaks, CA: Sage

Ganesh, R. B. (2008) *Motorola University* [online image] available from <http://www.slideshare.net/ganeshramb/motorola-university-presentation> [9 April 2016]

Garland, H. 1999. ‘Management Research and Management Practice: Learning from Our Colleagues in Economics’. *Impact Analysis: How Research Can Enter Application and Make a Difference* (L. Larwood and U.E. Gattiker, Editors). Mahwah, New Jersey: Lawrence Erlbaum Associates

Garner, W. R. (1960, November) ‘Rating Scales, Discriminability, and Information Transmission’. *Psychology Review* 67, 343–52

Garner, W. R. and Hake, H. W. (1951, November) ‘The Amount of Information in Absolute Judgments’. *Psychological Review* 58 (6), 446–451

Ghiselli, E. and Brown, C. (1948) *Personal and Industrial Psychology*. New York, New York: McGraw-Hill

Gillespie, R. (1991) *Manufacturing Knowledge*, Cambridge, England: Cambridge University Press

Glaser, E. M., Abelson, H. H., and Garrison, K. N. (1983) *Putting Knowledge to Use: Facilitating the Diffusion of Knowledge and the Implementation of Planned Change*. San Francisco, California: Jossey-Bass

Golafshani, N. (2003, 1 December) ‘Understanding Reliability and Validity in Qualitative Research’. *The Qualitative Report* 8 (4), 597–606

Gonçalves, M., Cardoso, C., and Badke-Schaub, P. (2014) ‘What Inspires Designers? Preferences on Inspirational Approaches During Idea Generation’. *Design Studies* [online] 35 (1), 29–53 doi:10.1016/j.destud.2013.09.001 [12 December 2014]

Gorb, P. (1986). ‘The Business of Design Management’. *Design Studies* [online] 7 (2), 106–110. doi:10.1016/0142-694X(86)90023-2 [18 October 2015]

Gordon, R. A. and Howell, J. E. (1959) 'Higher Education for Business'. *The Journal of Business Education* [online] 35 (3), 115–117 doi:10.1080/08832323.1959.10116245 [4 June 2015]

Grady, B. and Schoenfeld, G. (2006) Marketers with MBAs: Bridging the Thinking-Doing Divide. *Marketing Intelligence & Plan* [online] 24, 257–282. doi:10.1108/02634500610665727 [2 May 2015]

Graph Pad Software (2009) *What is the Difference Between Ordinal, Interval and Ratio variables? Why Should I Care?* [online] available from <http://www.graphpad.com/support/faqid/1089/> [25 August 2016]

Gregory, J. (2003) 'Scandinavian Approaches to Participatory Design. *International Journal of Engineering Education* 19, 62–74

Grey, C. (2001) 'Re-imagining Relevance: A Response to Starkey and Madan'. *British Journal of Management* 12, S27–S32

Grix, J. (2010) *The Foundations of Research*. Basingstoke, New York: Palgrave Macmillan

Guidry, J. A., Hollier, B. N. G., Johnson, L., Tanner, J. R., and Veltsos, C. (2004) 'Surveying the Cites: A Ranking of Marketing Journals Using Citation Analysis'. *Marketing Education Review* [online] 14, 45–59 doi:10.1080/10528008.2004.11488853 [8 August 2015]

Guilford, J. P. (1954) *Psychometric Methods*. New York, New York: McGraw-Hill

Guion, L. A. (2011) *Triangulation: Establishing the Validity of Qualitative Studies* [online] available from <https://sites.duke.edu/niou/files/2014/07/W13-Guion-2002-Triangulation-Establishing-the-Validity-of-Qualitative-Research.pdf > [27 April 2014]

Guthrie, D. (2013, 13 January) 'Corporate Universities: An Emerging Threat to Graduate Business Education' *Forbes* [online] available from <http://www.forbes.com/sites/dougguthrie/2013/01/22/corporate-universities-an-emerging-threat-to-graduate-business-education/#3659b8cd67fb> [20 July 2014]

Guthrie, D. (2013) 'Corporate Universities: An Emerging Threat to Graduate Business Education' *Forbes* [online] available from <http://www.forbes.com/sites/dougguthrie/2013/01/22/corporate-universities-an-emerging-threat-to-graduate-business-education/> [11 February 2016]

Hakel, M. D. (1994) 'The Past, Present and Future of OB Applications by Consulting Academicians'. *Organizational Behavior*: *The State of the Science* (J. Greenberg, Editor). Hillsdale, New Jersey: Lawrence Erlbaum Associates

Hands, D. (2009) *Vision and Values in Design Management*. Lausanne, Switzerland: AVA Publishing

Hardin, D., Westcott, M., and Berno T. (2014) 'Redesigning Graduate Education' *dmiReview* [online] 25 (1), 12-21 available from <http://onlinelibrary.wiley.com/wol1/doi/10.1111/drev.10267/full> [14 August 2015]

Harvard Business Review (2015 December) [online] available from <https://hbr.org/archive-toc/BR1512> [7 Jan 2016]

Harvard Business School (n.d.) *Statistics Overview* [online] available from <http://www.hbs.edu/about/facts-and-figures/Pages/statistics.aspx> [22 December 2014]

Hatchuel, A., Weil, B., and Le Masson, P. (2013) 'Towards an Ontology of Design: Lessons from C-K Design Theory and Forcing'. *Research in Engineering Design* [online] 24, 147–163. doi:10.1007/s00163-012-0144-y [21 May 2015]

Heskett, J. (1989) *A Study of Corporate Management Design*. New York, NY: Rizzoli

Industrial Designers Society of America (IDSA) (2015) *IDSA 2015 International Conference & Education Symposium* [online] available from <http://www.idsa.org/sites/default/files/pdfs/2015%20International%20Conference%20Sales%20Brochure%20-%20Jun%2015.pdf> [6 June 2015]

Institution of Engineers Australia (1996) 'Educating Engineers for a Changing Australia' *IEAust Report* [online] available from <http://trove.nla.gov.au/work/22682747?selectedversion=NBD13114359> [2 February 2015]

Institution of Engineers Australia (2008) 'Engineering Design: A National Asset. IEAust Position Paper [online] available from <https://www.engineersaustralia.org.au/engineering-design/what-engineering-design> [2 February 2015]

International Assembly for Collegiate Business Education (IACBE) *About the IACBE* [online] available from <http://iacbe.org/about-iacbe.asp> [23 May 2014]

Interval (n.d.) in Merriam-Webster [online] available at <www.merriam-webster.com> [4 September 2016]

Ivory, C., Miskell, P., Shipton, H., White, A., and Moeslin, K. (2006) *UK Business Schools: Historical Contexts and Future Scenarios* [online] Advanced Institute of Management Research Technical Report available from <https://www.researchgate.net/publication/240616360_UK_Business_Schools_Hi

storical_Contexts_and_Future_Scenarios_Summary_Report_from_an_EBKAIM_Management_Research_Forum> [4 May 2014]

Jacoby, A. and Baelus, C. (2013) 'Curriculum Differentiation for Masters in Product Development'. *DS 76: Proceedings of E&PDE 2013, the 15th International Conference on Engineering and Product Design Education, Dublin, Ireland, 05-06.09.2013,* '15th International Conference on Engineering and Product Design Education'. held 5-6 September 2013 at Dublin Institute of Technology. Dublin, Ireland: The Design Society, 654–659

Johannessen K., (2006A). 'Knowledge and Reflective Practice'. *Dialogue, Skill & Tacit Knowledge* (B. Göranzon, M. Hammarén, and R. Ennals R., Editors). New York, New York: John Wiley & Sons

Johns, G. (1993) 'Constraints on the Adoption of Psychology-Based Personnel Practices: Lessons from Organizational Innovation'. *Personnel Psychology* 46, 569–592.

Junginger, S. (2009, February) 'Design in the Organization: Parts and Wholes'. *Design Research Journal* [online] available from <http://www.academia.edu/213937/Design_in_the_Organization_Parts_and_Wholes> [12 May 2014]

Kahn, W. A. (2001) 'Holding Environments at Work'. *The Journal of Applied Behavioral Science* 37 (3), 260–279

Kahn, W. A. (2007) 'Commentary: Positive Relationships in Groups and Communities'. *Exploring Positive Relationships at Work: Building a Theoretical and Research Foundation* (J. E. Dutton and B. R. Ragins, Editors), 277–288. Mahwah, New Jersey: Erlbaum.

Kiernan, L. and Ledwith, A. (2014) 'Is Design Education Preparing Product Designers for the Real World? A Study of Product Design Graduates in Ireland'. *The Design Journal* [online] 17 (2). available from <http://www.tandfonline.com/doi/abs/10.2752/175630614X13915240576022?journalCode=rfdj20> [14 April 2014]

Koch, A. J. (1997) 'Definition and evaluation of competence, capability and skills gaps in international business'. *Journal of Marketing Practice: Applied Marketing Science* 3 (2), 119–151

Kolb, D. A. (1984) *Experiential Learning: Experience as the Source of Learning and Development*. New Jersey: Prentice-Hall.

Kolko, J. (2015a) 'A Process for Empathetic Product Design'. *Harvard Business Review* [online] available from <https://hbr.org/2015/04/a-process-for-empathetic-product-design> [30 March 2016]

Kolko, J. (2015b) 'Design Thinking Comes of Age'. *Harvard Business Review* [online] available from <https://hbr.org/2015/09/design-thinking-comes-of-age> [15 May 2016]

Kotler, J. (1998) *Principles of Marketing*. Australia: Prentice Hall Australia

Komorita, S. S. and Graham, W. K. (1965) 'Number of Scale Points and the Reliability of Scales'. *Educational and Psychological Measurement* 25 (4), 987–995

Landman, F. (2000) *Events and Plurality*. Norwell, Massachusetts: Kluwer Academic Publisher.

Leontif, W. (1982) 'Academic Economics'. *Science* 217, 104-107

Lewis B. and Bonollo E. (2002) An Analysis of Professional Skills in Design: Implications for Education and Research. *Design Studies* (23), 385–406

LoBiondo-Wood, G.; Haber, J. (2014) Nursing Research; Methods and Critical Appraisal for Evidence-Based Practice; ED8

Lockwood, T. (2015, 18 November) 'Design Leadership: What's Next?' *Fast Company* [online] available from < https://www.fastcodesign.com/3053681/design-leadership-whats-next> [12 December 2015]

Maciver, F. and O'Driscoll, A. (2010) 'Consultancy Designer Involvement in New Product Development: Mapping A Novel Design Leadership Process'. 'International Product Development Management Association Conference'. held June 2010 at Universidad De Murcia. Murcia, Spain

Malpass, M. (2012) Contextualising Critical Design: Towards a Taxonomy of Critical Practice in Product Design. PhD thesis [online]. Nottingham: Nottingham Trent University, available from <http://ualresearchonline.arts.ac.uk/6102/1/Contextualising_critical_design.pdf> [21 June 2015]

Mangum, S. L. and Wruck, K. H. (2011) 'Rethinking the MBA: Business Education at a Crossroads'. *Journal of Higher Education* 82, 661–664

Markides, C. (2007) 'In search of ambidextrous professors'. *Academy of Management Journal* 50, 762 - 767

Martin, R. L. (2009) *The Design of Business: Why Design Thinking is the Next Competitive Advantage*. Boston, Massachusetts: Harvard Business Press

Matell, M. S. and Jacoby, J. (1972) 'Is There an Optimal Number of Alternatives for Likert-Scale Items? Effects of Testing Time and Scale Properties' *Journal of Applied Psychology* [online] 56, (6), 506-509. available from

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.417.8264&rep=rep1&type=pdf> [25 August 2016]

Mathison, S. (1988). 'Why Triangulate?' *Educational Researcher* 17, 13–17.

McCole, P. (2004) 'Refocusing Marketing to Reflect Practice: The Changing Role of Marketing for Business'. *Marketing Intelligence & Planning* [online] 22, 531–539 doi: 10.1108/02634500410551914 [30 April 2014]

McKenna, A. F., Colgate, J. E., Carr, S. H., and Olson, G. B. (2006) 'IDEA: Formalizing the Foundation for an Engineering Design Education'. *International Journal of Engineering Education* 22, 671–678

McKenzie, J. and Swords, D. (2000) 'Maintaining Relevance in Business Education. A Framework for Exploring Alternative Teaching Paradigms'. *International Journal of Value-Based Management* 13, 273–295

Merriam, S. B. (2009) *Qualitative Research: A Guide to Design and Implementation*. San Francisco, California: Jossey-Bass

Miles, J. and Gilbert, P. (2005) *A Handbook of Research Methods for Clinical and Health Psychology*. Oxford: Oxford University Press

Miller, D., Greenwood, and Hinings, B. 1997. 'Creative Chaos Versus Munificent Momentum: The Schism Between Normative and Academic Views of Organizational Change'. *Journal of Management Inquiry* 6, 71–78

Minneman, S. L. (1991) The Social Construction of a Technical Reality: Empirical Studies of Group Engineering Design Practice. PhD thesis [online]. Stanford, California: Stanford University, available from <https://searchworks.stanford.edu/view/2149122 > [12 June 2015]

Mintzberg, H. (1973) *The Nature of Managerial Work*. New York, New York: Harper & Row

Mintzberg, H. (2009, May) 'Rethinking the MBA' [interview by P. Hemp] in *Harvard Business Review* [online] available from <https://hbr.org/2009/03/rethinking-the-mba> [4 March 2015]

Moggridge, M. (n.d.) *Celebrating Bill Moggridge* [cached online] available from <http://webcache.googleusercontent.com/search?q=cache:gtWF0aApyzEJ:www.billmoggridge.com/celebration/%3Fcat%3D6+&cd=1&hl=en&ct=clnk&gl=us> [4 August 2016]

Moor, T. N. and English, S. G. (2013) 'Reflections on Multiple Perspective Problem Framing'. *International Journal of Design Management and Professional Practice* 6, 29–50

Morris, M. H. (2014) *Annals of Entrepreneurship Education and Pedagogy*. Cheltenham, UK: Edward Elgar Publishing

Morse, J. M. (1994) Critical Issues in Qualitative Research Methods. Thousand Oaks, California: Sage

My Market Research Methods (2015) *Types of Data & Measurement Scales: Nominal, Ordinal, Interval and Ratio* [online] available from <http://www.mymarketresearchmethods.com/types-of-data-nominal-ordinal-interval-ratio> [4 September 2016]

Munshi, J. (2014) 'A Method for Constructing Likert Scales' SSRN [online] doi: 10.2139/ssrn.2419366 [4 September 2016]

National Science Foundation (n.d.) FY 2015 Budget Request [online] available from <https://www.nsf.gov/about/budget/fy2015/> [4 October 2015]

Norman, D. (2011) Wir brauchen neue Designer! Why Design Education Must Change [online] available from <http://www.researchgate.net/profile/Donald_Norman/publication/235700801_Wir_brauchen_neue_Designer!_Why_Design_Education_Must_Change/links/54a2b47e0cf256bf8bb0d448.pdf> [26 August 2015]

Northwestern University (n.d.) *Executive Education Program* [online] available from <https://segal.northwestern.edu/docs/program/mpd/exec_ed_brochure.pdf > [18 November 2014]

Northwestern University Robert R. McCormick School of Engineering and Applied Science (2016) Explore McCormick [online] available from <http://www.mccormick.northwestern.edu/explore/> [3 February 2016]

Otani, A. (2015, 13 April) 'The Value of a College Degree is More Obvious Than Ever'. *Bloomberg Businessweek* [online] available from <http://www.bloomberg.com/news/articles/2015-04-13/job-opportunities-are-improving-for-college-graduates> [12 June 2015]

Oviatt, B. M., and Miller, W. D. (1989) 'Irrelevance, Intransigence, and Business Professors'. Academy of Management Executive 8 (2), 7–8

Oxman, R. (1999) 'Educating the Designerly Thinker'. *Design Studies* [online] 20, 105–122. doi:10.1016/S0142-694X(98)00029-5 [27 October 2015]

Oxman, R. (2006) 'Theory and Design in the First Digital Age'. *Design Studies* [online] 27, 229–265. doi:10.1016/j.destud.2005.11.002 [8 July 2015]

Oyemeka Ughanwa, D. (1988) 'In Search of Design Excellence'. *Design Studies* [online] 9, 219–222. doi:10.1016/0142-694X(88)90006-3 [8 May 2016]

Pappas, E. (2002) Creative Problem Solving in Engineering Design [online] available from <http://www.jmu.edu/ihot/Pappas2002.pdf > [11 November 2014]

Patterson, J. (2014, 21 October) *Hiring Remains Robust for Vanderbilt's MBA Class of 2014* [online] available from <http://news.vanderbilt.edu/2014/10/hiring-mba-class-2014/> [4 October 2015]

Patton, M. Q. (2001) 'Two Decades of Developments in Qualitative Inquiry: A Personal, Experiential Perspective'. *Qualitative Social Work* [online] 1, 261–283. doi:10.1177/1473325002001003636 [6 February 2015]

Petersen, S. (2015, 16 March) 'Design Centric—What Is It in Practice?' *The Huffington Post* [online] <http://www.huffingtonpost.com/soren-petersen/design-centric---what-is_b_6881918.html> [8 May 2016]

Pernecky, J.(1963) *Action Research Methodology; Bulletin of the Council of Research in Music Education.* University of Illinois Press <http://www.jstor.org/stable/40375233>

Pettigrew, A. (1973) *The Politics of Organizational Decision-Making*. London, UK: Tavistock Institute

Pfeffer, J. (1998) T*he Human Equation: Building Profits by Putting People First*. Brighton, Massachusetts: Harvard Business School Press. PhD thesis [online]. Williamsburg, VA: The College of William and Mary, available from <http://gradworks.umi.com/33/57/3357528.html> [21 June 2015]

Qing Li (2013) 'Proceedings'. 'Web Engineering: 13th International Conference' held 2013, Aalborg

Reibstein, D. J., Day, G., and Wind, J., (2009) 'Guest Editorial: Is Marketing Academia Losing Its Way?' *Journal of Marketing* [online] 73, 1–3. doi:10.1509/jmkg.73.4.1 [4 March 2015]

Relevant Research' *Academy of Management Journal*, 50 (6): 1323–33 available <http://www.cerag.org/sites/default/files/Avenier/Bartunek%20AMJ%202007.pdf > [7 January 2015]

Reuther, D. and Jetton. S. (2013) 'Stop Managing Projects and Start Leading with Story'. *dmiReview* 24 (1), 28–35

Ritz, J. (2014) *Notetaking Guides: Aims, Goals and Objectives* [online] available from <http://ww2.odu.edu/~jritz/oted885/ntg9.shtml> [4 September 2016]

Ritz, J (2009, Spring) 'A New Generation of

for Technology Education'. *Journal of Technology Education* 20, (2), 50–64

Rogers, E. M. (1995) *Diffusion of Innovations*. New York, New York: The Free Press

Rubin, H. J. and Rubin, I. (2012) *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks, California: Sage

Rust, C., Motram, J., and Till, J. (2007, November) 'Practice-Led Research in Art, Design and Architecture'. *AHRC Research Review* [online] November, available from <http://arts.brighton.ac.uk/__data/assets/pdf_file/0018/43065/Practice-Led_Review_Nov07.pdf> [11 December 2015]

Russell, C. J. and Bobko, P. (1992) 'Moderated Regression Analysis and Likert Scales: Too Coarse for Comfort'. *Journal of Applied Psychology*, 77 (3), 336–342

Rynes, S. L., McNatt, D. B., and Bretz, R. D. (1999) 'Academic Research Inside Organizations: Inputs, Processes, and Outcomes'. *Personnel Psychology* 52, 869–898

Rynes, S.L., Bartunek, J.M., and Daft, R.L. (2001) 'Across the Great Divide: Knowledge Creation and Transfer Between Practitioners and Academics' *Academy of Management Journal* [online] 44 (2), 340-355. doi:10.2307/3069460 [10 October 2015]

Sackett, P. R. and Larson, J. R. (1990) 'Research Strategies and Tactics in Industrial and Organizational Psychology'. *Handbook of Industrial & Organizational Psychology* (2nd edition, M. D. Dunnette and L. M. Hough, Editors) Vol. 1, 419–489. Palo Alto, California: Consulting Psychologists Press, Inc.

Schoenfeld, G. (2014) 'An MBA Holds its Perceived Value, Even in Lean Times'. *Harvard Business Review* [online] available from <https://hbr.org/2014/03/an-mba-holds-its-perceived-value-even-in-lean-times> [16 May 2016]

Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*. New York, New York: Basic Books

Schumpeter, J. A. (1911) *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*. London, UK: Transaction Publishers

Schutze, M., Sachse, P., and Romer, A. (2003) 'Support Value of Sketching in the Design Process'. *Research in Engineering Design* 14 (2), 89–97

Seliger, G. (2001) 'Product Innovation: Industrial Approach—CIRP Annals'. *Manufacturing Technology* [online] 50, 425–443. doi:10.1016/S0007-8506(07)62989-8 [11 April 2015]

Shrivastava, P. and Mitroff, I. I. (1984) 'Enhancing Organizational Research Utilization: The Role of Decision Makers' Assumptions' *The Academy of*

Management Review [online] 9, 18–26. available from <http://dx.doi.org/10.2307/258228> [14 June 2014]

Solent Online Learning [online] available from <http://learn.solent.ac.uk/mod/book/view.php?id=2744&chapterid=1293Learn.solent.ac.uk.> [n.d.]

Solomon and Matthews (2014) 'The Curricular Confusion Between Entrepreneurship Education and Small Business Management: A Qualitative Analyses' in *Annals of Entrepreneurship Education and Pedagogy* (M. H. Morris, Editor). Cheltenham, UK: Edward Elgar Publishing, Ltd.

Stahl, M. J., Leap, T. L., and Wei, Z. Z. (1988) 'Leadership for a Changing World: The Future Role of Graduate Management Education'. *Academy of Management Journal* 31 (3), 707–720

Stanton, A. (2006, May) 'Bridging the Academic/Practitioner Divide in Marketing'. *Marketing Intelligence & Planning* 24 (3), 233–244

Susman, G. I. and Evered, R. D. (1978) 'An Assessment of the Scientific Merits of Action Research'. *Administrative Science Quarterly* 23, 582–603

Tailor, S. and Tailor, P. (n.d.) *New Product Development* [online] available from <http://www.learnmarketing.net/npd.htm> [17 June 2016]

TED (n.d.) *Our Organization* [online] available from <https://www.ted.com/about/our-organization> [5 September 2015]

Teng, C. L. (1994) Product Design Management: The Importance of Communication Between Managers and Industrial Designers. PhD thesis. Manchester, UK: Manchester Metropolitan University

The Aspen Institute (n.d.-a) *Our Mission* [online] available from <https://www.aspeninstitute.org/our-mission/> [8 September 2014]

The Aspen Institute (n.d.-b) *Our Program* [online] available from <https://www.aspeninstitute.org/program/> [17 March 2015]

Thomas, G. (1997) 'What's the Use of Theory?' *Harvard Educational Review* 67, 75–104

Thomas, K. W. and Tymon, W. G. (1982) 'Necessary Properties of Relevant Research: Lessons from Recent Criticisms of the Organizational Sciences'. *Academy of Management Review* 7, 345–352

Thompson, B. (2004) *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. Washington, DC: American Psychological Association

Topalian, A. (1984) 'The Role of Company Boards in Design Leadership'. *Engineering Management International* [online] 2, 75–86. doi:10.1016/0167-5419(84)90056-5 [12 October 2014]

Topalian, A. (1986) The Documentation of Corporate Approaches to Design Management to Share Experience and Improve Performance'. *Engineering Management International* [online] 4, 51–60. doi:10.1016/0167-5419(86)90007-4 [11 May 2015]

Tovey, M. M. (2015) *Design Pedagogy: Developments in Art and Design Education*. Burlington, Vermont: Ashgate Publishing, Ltd.

Tuder, S. (2014) *Hamburger University* [online image] available from <http://abcnews.go.com/blogs/lifestyle/2014/04/mcdonalds-hamburger-university-is-no-joke/> [22 April 2015]

Turner, R. (2013) *Design Leadership: Securing the Strategic Value of Design*. London, UK: Gower Publishing

Ujang, B. (2000) A Study of Collaboration Between University Industrial Design Departments and Corporate Firms. PhD thesis. Columbus, Ohio: Ohio State University

Ulrich, K. T. and Eppinger, S. D. (2012) *Product Design and Development*. Irwin, New York: McGraw-Hill

University of Cincinnati College of Engineering (n.d.) Advanced Teaching Techniques: Aims, Goals, and Objectives [online] available from <http://www.ece.uc.edu/~pffp/fft_Aims.html> [4 September 2016]

USA Study Guide (n.d.) *US Regions and States: How Do They Differ?* [online] available from <http://www.usastudyguide.com/regionaldifferences.htm> [2 November 2016]

US Diplomatic Mission to Germany/ Pubic Affairs/ Information Resource Centers [online] availbe from < https://usa.usembassy.de/travel-regions.htm> [May 2008]

US News and World Report (2016) *Best Engineering Schools* [online] available from <http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/eng-rankings?int=a74509&int=a74509> [11 April 2014]

Van Aken, J. E. (2001) Mode 2 Knowledge Production in the Field of Management'. 'Eindhoven Centre for Innovation Studies' [Working Paper] Eindhoven, Netherlands: Technische Universiteit

Van Maanen, J. (1988) *Tales of the Field: On Writing Ethnography*. Chicago, IL: University of Chicago Press

Veryzer, R. W. and de Mozota, B. B. (2005) 'The Impact of User-Oriented Design on New Product Development: An Examination of Fundamental Relationships'. *Product Innovation Management* 22 (2), 128–143

Walliman, N. (2011) *Your Research Project: Designing and Planning Your Work*. Thousand Oaks, California: Sage

Walliman, N. S. R. (2011) *Research Methods: The Basics*. New York, New York: Routledge

Weightman, D. and McDonagh, D. (2006) 'The New Landscape Of Design: Cool Hunting And Other Opportunities'. 'Industrial Designers Society of America (IDSA) National Conference and Education Symposium'. held 17–20 September, Austin, Texas.

Wenger, E. (2000, May) 'Communities of Practice and Social Learning Systems'. *Organization* 7 (2), 225–246

Westcott, M. (2014, 10 March) 'Design-Driven Companies Outperform S&P by 228% Over Ten Years—The "DMI Design Value Index"'. *Design Management Institute* [online] available at <http://www.dmi.org/blogpost/1093220/182956/Design-Driven-Companies-Outperform-S-P-by-228-Over-Ten-Years--The-DMI-Design-Value-Index> [14 April 2014]

Wilson, J. A. (2011) Core Design Aspects. PhD thesis. Manchester: UK: University of Manchester

Wittink, D. R and Bayer, L. R. (2003) 'The Measurement Imperative'. Marketing Research 15, 19–22

Wohlfarth, J. (2002) ‘Making the Grade’. *International Design* [online] 49, 54–59. available from <http://www.ritasue.com/downloads/ID_> [8 August 2016]

Wood, W. H. (2004) ‘Decision-Based Design: A Vehicle for Curriculum Integration’. *International Journal of Engineering Education* 20 (3), 433–439

Worrall, L. (2008) ‘Management Research and Management Practice: Is the Relevance Gap Closing?’ *International Journal of Management Concepts and Philosophy* [online] 3, 1–18 doi:10.1504/IJMCP.2008.018523 [11 November 2015]

Wrigley, C. and Bucolo, S. (2011) ‘Teaching Design Led Innovation: The future of Industrial Design’ *Design Principles and Practices* [online] 5 (2), 231-240 available from <http://eprints.qut.edu.au/42592/4/42592a.pdf> [6 January 2015]

Yin, R. K. (2011) *Applications of Case Study Research*. Thousand Oaks, California: Sage

Yin, R. K. (1981) ‘The Case Study Crisis: Some Answers’. *Administrative Science Quarterly* 26 (1), 58–65. doi: 10.2307/2392599

Yin, R. K. (2013, July) ‘Validity and Generalization in Future Case Study Evaluations’. *Evaluation* 19 (3), 321–332. doi: 10.1177/1356

9013497081

Zinkham, G. M. (2003) ‘From the Editor-Elect: A Look at the Future of JAM: Three Years Out, Thirty Years Out’. *Journal of the Academy of Marketing Science* 31, 226

Appendix A Academic Spread Sheet

Appendix B Definitions and Terms

AACSB	The Association to Advance Collegiate Schools of Business
ABET	Accreditation Board for Engineering and Technology
Alumni	Alumni are defined in this paper as those from one US institution awarding a degree in 'product design and development management'
Capstone	A dedicated course devoted to referencing various subject matter as an integrated unit
Course(s)	Individual taught subject
Comparative studies	Research devoted to specific types of subjects
Competence	Having achieved a skill level that affords usage within an area of specialty
Communications	Referring to coursework and the resulting skills of being able to succinctly present via writing, speaking, and/or formally presenting
Contextual interview	An interview technique that is 'one on one' between the interviewee and the interviewer
Corporate	References US based companies
Engineering Design	ABET definition is the process of devising a system component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. www.me.unlv.edu/Undergraduate/coursenotes/.../ABETdefinition.htm
Design Centric	Those organizations that represent a general sensitivity to design, not only of discrete products but also relates to over-all corporate design as well as service design.
ESOP	Employee Owned Stock Ownership Plan. A US based method, approved by the Internal Revenue Bureau, to transfer, for kind, shares of a company to employees
Excellence	Having achieved a 'high' level within an area
HLB	Design firm, Herbst LaZar Bell, later changed to HLB founded in Chicago in 1965, grew to be over 100 professional in Boston, Chicago, and Orange County, California
IDSA	Industrial Design Society of America

Industry	General reference to ‘business’
Institutional	Specifically relating within this context to schools of higher learning
Interpretivism	Also known as antipositivism …is the belief in social science
Integration programme	Coursework dedicated to the totality of the subject to include design, engineering and business
Managing Director	A title reserved for an individual in charge of a department
MFA	Master of Fine Art
MPDD	Master of Product Design and Management
NU	Northwestern University
Product Design	A process by which one creates either a discrete or non-discrete item that can be used in commerce or service
Product Development	The range of activities that is required for creating a product or service, starting with understanding of needs, followed by ideation and engineering for production.
Proficiency	Relates to a level of skill. There can be those with a low or high
Purposive sampling	judgmental based on existing knowledge of defined group for purpose of the study
Qualitative research	Refers to a smaller subset of the larger audience. For this usage I am referencing fewer than 100 responses, which could developed as participant interviews
Quarter	Northwestern university in the US as well as some other institutions, has their year divided into fall, winter, spring, summer quarters. A typical “1 year” of schooling would entail a fall, winter, spring sequence
Subject	Can be used interchangeably with ‘course’
Thumbnail sketches	Minimal ideations, that are always done by hand, in order to quickly translate an idea into a visual
Triangulation research	Using 2 (or more) data sources for confirmation of qualitative
White space	A place within ‘the market’ of goods, to include both service and discrete, that is void of product

Appendix C Names

Appendix C		
Birmingham City Unviersity (England)	Design Management -MA	
Barcelona School of Dsgn & Eng ELISAVA (Spain)	M Advncd Dsgn Mnmngt; Strat & Entr	
Institute of Design IIT	M Dsgn / MBA	
Cranfield Univeristy (England)	M Dsgn in Dsgn, Strat, ldrshp	
University of Penn (Upenn)	M Integ Prod Dsgn	3
Carnegie Mellon Univ	M of Integ Inn for Prod &Services	
Virgina Commwealth U. da Vinci Ctr	M Prod. Innovation	
MIT SDM (System Dsgn & Management	M Sc in Integrated Design &Mngmnt	
Northwestern University	M Sc in PD&D Mngmnt	2
Rochester Inst Technology	M Sc in Prod Devel	3
TU/e Technische Universiteit Eindhoven (Netherlands)	M Sc Innovation Mgmnt	
Univ of Applied Sciences Upper Austria	M Sc Innvatn & Prod Dsgn.	
KTH Royal Inst. Of Technology (Sweden)	M Sc Integrated Prod Dsgn	3
Brunel University London	M Sc Integrated Product Design	3
University of Warwick (England)	M Sc PD &D Mgmnt	2
University of Glasgow	M Sc Prod Desgn Eng	
University of Detroit Mercy	M Sc Prod Devel	3
Cardiff School of Art and Dsgn (Wales)	M Sc Prod Dsgn	
Aston University (England)	M Sc Prod Dsgn Innovation	
Bournemouth University (England)	M Sc Product Design	
Parsons The New School of Design	M Sc Strategic Design and Management	
Intl Hellenic University (Greece)	M Sc Strategic Prod Dsg	
Chalmers U of Tech (Sweden)	M Sc. Prod Devel	3
University of Liverpool (England)	M Sc(Eng) P Dgn & Mgmnt	
Univ De Los Emprendedores (EAN) (Columbia)	M Strat Dsgn Mngmnt	
Poli Design (Politecnico di Milano (Italy)	M Strategic Dsgn	
Lancaster University (England)	MA Dsgn Management	4
San Francisco State Univ.	MA in Industrial Arts	
IED Barcelona (Spain)	Master in Design Management	4
Kendall Clg of Art&Dsgn of Ferris State U	MBA Cert.in Dsgn & Innov Mgmt	
California College of the Arts	MBA in Design Strategy	
Philadelphia University	MBA Strategic Design	
Maryland Institute College of Art	MBA/MA Design Leadership	
Schulich Schl of Bus (York Univ) (Canada)	MBA/MFA	
SCAD The University for Creative Careers	MFA Design Management	4
Pratt Institute	MPS (Mstr Prof Studies) in Dsgn Mgmt	4
Loughborough University (England)	MSc Entreprenerial Dsg Mgmnt	
Milwaukee School of Engineering MSOE	MSc in New Product Managment	
NOTE: common colours represent common names		

Appendix D Design-Centric Industry Professionals

Dr William E. Brown III, Chief Scientific Officer, IDEXX Laboratories

Hugh Ekberg, President, Kitchen and Bath, Kohler Co.

Kevin Gilboe, Head of Global Design, Consumer Business, Group 3M

Cass Grandone, Divisional VP, Systems Development & Core R&D, Abbott Laboratories

Gretchen Gscheidle, Director, Strategic Research and Advanced Development, Herman Miller

Neil Willcocks, Global VP, R&D, Wm. Wrigley and Company

Jim Wicks, Corporate VP, Consumer Experience Design, Motorola, Inc.

Bracken Darrell President, CEO Logitech

Steve D'Amico, Design Director, Proctor & Gamble

Lauren Lackey, VP, Global Cleaning, RD&E, SC Johnson

Matt Levatich, President, CEO, Harley-Davidson Motor Company

Bob Schwartz, Director of Design, GE Healthcare

Tom Gale, Sr VP–Director of Design, Chrysler (retired)

Mike Otterman, VP Global Merchandise and Marketing, The Coleman Company

Joe Prybell, Director, R&D, Beckton Dickenson

Tom Tobin, VP R&D, S&C Electric

Doug Stone, Sr VP Innovation, Maddock Douglas

Gus Zimmerman, Technical Director, Alcatel-Lucent

John Sidor, Director, Mission Assurance, Northrop Grumann

Sumant Ramachandra, Chief Scientific Officer, Abbott Laboratories

Bob Schwartz, General Manager, Global Design, GE Healthcare

Appendix E Interviewees from Educational Institutions

Jonathan Jelen, Assistant Professor, School of Design Strategies, Parson's, The New School for Design

Natalie W. Nixon, Associate Professor and Director, Philadelphia University

David Gracyalny, Dean, Maryland Institute College of Art

Eric Anderson, Co-Director, Associate Professor, Carnegie Mellon University

Sara L. Beckman, Faculty Director, Haas School of Business, UC Berkeley

Craig Vogel, Associate Dean, College of DAAP, University of Cincinnati

Nathan Shedroff, Programme Chair, California College of the Arts

Greg Holderfield, Director, Associate Professor, Segal Design Institute Northwestern University

Bill Lee, Programme Coordinator, Savannah College of Art and Design (SCAD)

Ken Kohn, Director, Innovation Center, Virginia Commonwealth Da Vinci Center, Rochester Institute of Technology

Helen Nugent, Programme Chair, School of the Art Institute of Chicago

Dr David Cameron, Director, University of Detroit Mercy

Matt Kressy, Director, Massachusettes Institute of Technology (MIT)

Sarah Rottenberg, Associate Director, University of Pennsylvania

Appendix F Questionnaire—Initial Interview (Industry Leaders)

The following is coursework I have found on the sites of programmes similar (in branding) to ours.

I would appreciate your taking a look so that I'm not blind-siding you when we talk. I only need a quick response on a scale of 1 – 10 (not good – good) in terms of coursework relative to what you think should be taught for the person you have or wish to have running your product design and development group.

Just read them through now, appreciating the name you might give them could be different than those I have used. I would prefer your response when I call rather than your answering and sending this back..

Introduction and overview of product design and development and/or innovation management (overview of the subject)

Communications (written / verbal / skills to include presentations)

Organizational Behavior (appreciation for the nuances of working w/ others)

Material Selection (not a science based but an overview of why and what materials to choose)

Negotiation (honing skills in both negotiations and conflict resolution)

Accounting (very basic understanding of principles)

Finance (appreciate of management of money for a company)

Creativity and Innovation (awareness of and techniques to sharpen ones skills in creativity)

Decision Making (learning to deal with uncertainty as a designer and/or developer of products)

Theory of Product Design (understanding through and of design)

Methodology of Product Design (the framework of various methods of product design)

Branding and/or Design Strategy (*understanding* what to make and do, why do it and how to innovate contextually)

Market Research (appreciation of market factors that will aid in the process)

Statistics (appreciating statistical variations and design of experiments)
Industrial Design or ID Engineering (appreciation, knowledge and application of fundamental design thinking approach to solving design challenges, innovating and communicating concepts and appreciating the manufacturing processes to reduce design to practice.)

Operations (understanding the *management* in addition to understand the directing of the physical [or technical functions] of a an organization, specifically related to development, production, and manufacturing.

Software Management (learning techniques to manage those individuals and/or groups responsible for the actual development of software)

Design protection / Intellectual Capitol Strategy (appreciating the nuances of patents, trademarks and copy write, both as a tactic but as a strategy)

Manufacturing or lean design (understanding and appreciating the management of optimizing design for manufacture)

Human Factors (appreciating the study of human centered design for products that might include cognition and the understanding of the underlying physiology, anthropometrics and psychology)

Supply Chain or Global Design or Global Product Development (understanding the world stage for producing product in markets other than where they may be designed or sold, and appreciating the nuances of working long distance with teams for development)

Marketing (basic understanding of segmentation, targeting and positioning as well as appreciating the "4 P's" of product; price; promotion; place)

Ethics (the understanding and practice of behavior dealing with concepts of right and wrong)

Leadership (understanding effective leadership skills and theory, encouraging leadership as a motivator for others)

Thesis or major capstone (an individual or team project that reflects general learning's in the subject of design and development)

Business planning / Entre(intre) preneurship / New Venture (developing business models as used in the starting a business from outside or within an existing company)

Computer Assisted Design (CAD) (understanding the use of computer systems to aid in the development of products to optimise design)

Environmental / Sustainable Design (Appreciating environmental issues as well as sustainability in the design and life of a product)
Product Life Cycle (the stages in the life of a product to help in determining the life span)

Finite Element Simulation (computer based analyses of a part to understand the underlying boundaries)

Mechatronics (combination of mechanical engineering, electrical engineering, and computer science and used in describing mechanical / electronic solutions)

Intro to Mechanical Engineering / Integrated engineering design (a primer for better appreciating the nuances of basic mechanical engineering)

Machine shop (the learning of subtractive techniques for fabrication purposes)

Rapid prototyping (the learning of additive techniques for fabrication and "growing" of prototypes)

Problem framing (the art of breaking down a complex problem into smaller problems)

Economics / Economics analyses / game theory (understand economic activity relative to production, distribution and consumption of goods within an economy)

History of Product Design (Appreciation of the history of the subject)

Visual Communication / Sketching (basic sketching skills to assure one can readily and quickly communicate an idea)

Design and applied theory / design science (scientific study of design – theory relating to design)

Philosophy of design (the study of assumptions, foundation, and implications of design. [Wikipedia])

Systems Management (the overview and administration of various systems)

Business and Capital markets (understanding financial markets)

Social Ventures (the solving of social problems or social benefits)

Research Methods (using anything from qualitative to quantitative to various samplings and analyses)

Trends / Design Futures (the study of forecasting and understanding global trends and challenges)

International studies (allow students to travel and learn in /from other cultures)

Appendix G Questionnaire (Follow-up Industry Leaders)

Background:
I had previously developed a survey of the views of 20 industry leaders, 90 graduates and 10 academic leaders who identified suitable study topics for managers of product design and development. Nine core topics emerged as essential to such studies. The nine core topics are listed below.

Your opinion is now sought on how closely these nine topics match your own expectations for leadership of PD&D. Please indicate to what extent you agree on a scale of 0-10.

(0 = strongly disagree, 10 = strongly agree)

Core Subjects: Popular name	Secondary name	Description
I agree		
	Intro to Product Design & Development	Foundation; Intro to Product Design	Overview of the process of design development
	Decision Making		Probabilistic concepts, modeling and methods for analyzing decisions
	Design Strategy	Branding	Understanding culture of innovation; collaboration, design language, user empathy, ethnography
	Leadership		Building trust, credibility and respect. Working with teams.
	Ethics	Regulations	Understanding core values. Ethics at the heart of leadership. Understanding
	Capstone	Thesis / Major project	Coursework consisting of identifying an opportunity, designing, engineering, manufacturing, costing and understanding supply chain. To include financial modeling

	Innovation	Creativity	Thinking out of the box, tools for creativity and innovation, brain storming
	Research methods		Various methods for understanding and collecting data.
	Problem framing		Interpreting events to allow for focus.

All results will be anonymous. Ethics approval for this study has been granted by the Faculty of Arts and Humanities, Coventry University UK.

Thank you so much for taking the time to help in this work.

Best,
Walter

Appendix H Academic Questionnaire

I would greatly appreciate your help in identifying course work that you find useful in your job. I am constantly trying to stay on top of identifying courses that are important in your professional lives and for this survey I have included classes you took as well as classes we are finding in other programs that could be of help in your job. Do not give a rating based on faculty, as we are only interested if the subject knowledge is important in your position or possibly in a position as you move on.

I will also use this information for my PhD work.

Before you answer, it is important we find out what your current job is, as well as what it was when you entered the program. I would also appreciate knowing when you graduated, as the questionnaire is anonymous.

Walter Herbst may use the following information for statistical purposes for his PhD thesis. Yes_____ No_____

My job / position prior to school

was_____

My current job / position is

_____

Please note importance by noting 1 – 10 with 1 being of little to no value in what you do.

Introduction and overview of product design and development

Communications

Organizational Behavior

Material Selection

Negotiation

Accounting

Finance

Creativity and Innovation

Decision Making

Theory of Product Design (understanding through and of design)

Methodology of Product Design (the framework of various methods of product design)

Branding and/or Design Strategy

Market Research

Statistics (appreciating statistical variations and design of experiments)

Industrial Design concepts

Operations / Project Management

Software Management

Design Protection / Intellectual Capital Strategy

Manufacturing or Lean Design

Human Factors

Supply Chain

Global Product Development

Marketing

Ethics

Leadership

Thesis / major capstone / business plan

Business planning / Entre(intre) preneurship / New Venture

Management Fundamentals

Environmental / Sustainable Design

Product Life Cycle

Problem framing

Economics / Economics analyses / game theory

History of Product Design (Appreciation of the history of the subject)

Visual Communication

Design and applied theory

Philosophy of design

Systems Management

Systems Design

Business and Capital markets

Social Ventures

Research Methods

Trends / Design Futures

International studies

Product Management

Evolution of Corporation…design of business

Cultural differences

Psychology

Project management

Strategic thinking

Name any other subject you would like to have knowledge of

Appendix I Alumni Graduate Questionnaire

I would greatly appreciate your help in identifying coursework that you find useful in your job. I am constantly trying to stay on top of identifying courses that are important in your professional lives and for this survey I have included classes you took as well as classes we are finding in other program that could be of help in your job. Do not give a rating based on faculty, as we are only interested if the subject knowledge is important in your position or possibly in a position as you move on.

I will also use this information for my PhD work.

Before you answer, it is important we find out what your current job is, as well as what it was when you entered the program. I would also appreciate knowing when you graduated, as the questionnaire is anonymous.

Walter Herbst may use the following information for statistical purposes for his PhD thesis. Yes_____ No_____

My job / position prior to school

was_____

My current job / position is

_____

Please note importance by noting 1 – 10 with 1 being of little to no value in what you do.

Introduction and overview of product design and development

Communications

Organizational Behaviour

Material Selection

Negotiation

Accounting

Finance

Creativity and Innovation

Decision Making

Theory of Product Design (understanding through and of design)

Methodology of Product Design (the framework of various methods of product design)

Branding and/or Design Strategy

Market Research

Statistics (appreciating statistical variations and design of experiments)

Industrial Design concepts

Operations / Project Management

Software Management

Design Protection / Intellectual Capital Strategy

Manufacturing or Lean Design

Human Factors

Supply Chain

Global Product Development

Marketing

Ethics

Leadership

Thesis / major capstone / business plan

Business planning / Entre(intre) preneurship / New Venture

Management Fundamentals

Environmental / Sustainable Design

Product Life Cycle

Problem framing

Economics / Economics analyses / game theory

History of Product Design (Appreciation of the history of the subject)

Visual Communication

Design and applied theory

Philosophy of design

Systems Management

Systems Design

Business and Capital markets

Social Ventures

Research Methods

Trends / Design Futures

International studies

Product Management

Evolution of Corporation…design of business

Cultural differences

Psychology

Project management

Strategic thinking

Name any other subject you would like to have knowledge of